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ABSTRACT

The New Jersey Department of Education, as part of its goal to modernize its learning environments, has established a Distance Learning Network Aid program. The program supplies funding to school districts to participate in a statewide technological network system designed to support achievement of the state's Core Curriculum Content Standards. This document provides guidelines to assist local districts and county coordinating councils in developing their distance learning plans. The first section addresses the educational specifications in the classroom design that reflect a technology-rich learning environment. The design and review processes and the organization of the educational specifications are discussed. The second section presents guidelines for modernizing learning environments with educational technology. The final section details the new areas of school activity created when a technology infrastructure is adopted, including the use of instructional television, media centers, TV production facilities, and distance learning. Appendices provide an sample of an educational specifications form, a glossary of communications technology terms, a clarification of electronic communication systems terms, specifications on wiring and classroom diagrams, and a study supplement program and recommendations. (GR)

New Jersey Department of Education

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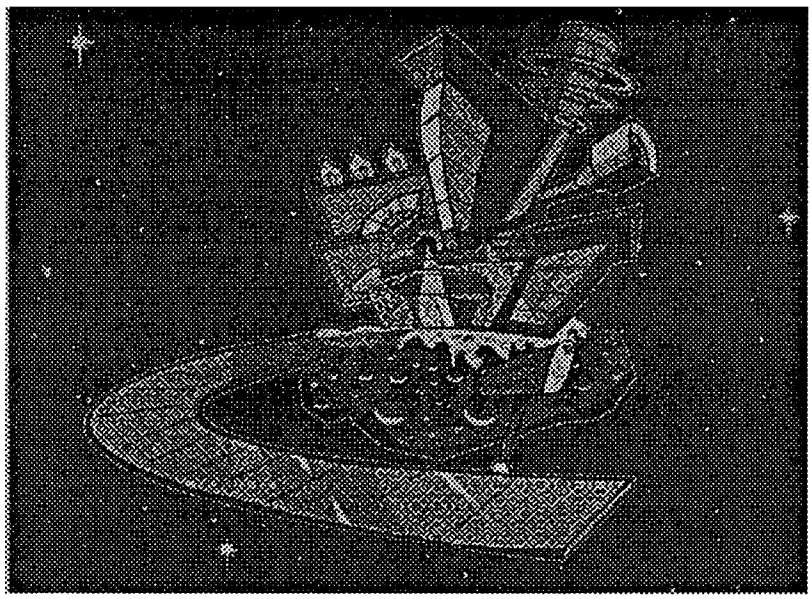
Facility Standards for Technology in New Jersey Schools



FACILITY STANDARDS FOR TECHNOLOGY IN NEW JERSEY SCHOOLS

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STATE BOARD OF EDUCATION

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PREFACE

As a result of the goal for modernizing learning environments in the educational technology state plan (*Educational Technology in New Jersey: A Plan for Action* [April 1993]), the department formed a task force to prepare technology specifications for voice/video/data access. The document, *Facilities Standards for Technology in New Jersey Schools* , provides guidelines on integrating technology infrastructure in new school construction and renovating/remodeling old schools. Originally prepared in October 1993, the document has been revised and updated several times.

This current document represents the most comprehensive version to date. It defines the components of technology, provides guidelines for new construction or to retrofit existing educational facilities, and describes what a "smart school" should contain to address both curriculum and automated management systems. It has been created to help educators as they focus efforts, both state and local, to tap the learning opportunities available through technology to address implementation of the Core Curriculum Content Standards.

On May 1, 1996, the New Jersey State Board of Education approved a comprehensive set of rigorous **Core Curriculum Content Standards** that dictate what every New Jersey student should know and be able to do at the end of the K-12 educational experience. These standards establish the high expectations which constitute a "thorough" education.

At the same time, an educational funding system based on the expected attainment of these standards was proposed and signed into law on December 20, 1996. The ***Comprehensive Educational Improvement and Financing Act of 1996*** [P.L.1996, c.40 (C.18A:7F-1 et seq.)] includes $50 million for **Distance Learning Network Aid,** beginning in the 1997-1998 school year. During 1997-1998, funds are distributed to school districts based on enrollments at $40 per student. This fund is to establish statewide distance learning networks with each district a member by the 2001-2002 school year.

This Distance Learning Network Aid program is intended to coordinate a statewide system that will maximize the use of technology networks that support academic instruction and provide access to remote resources for students to achieve the Core Curriculum Content Standards. To be eligible for continuation of the aid, school districts are required to develop five-year distance learning network plans that are

coordinated with county distance learning plans. This document is intended to assist local districts and county coordinating councils in the development of the distance learning plans.

INTRODUCTION

This guide is intended for school leaders and design professionals who are aware of the potential of technology in creating a school to help provide the means for students to be successful in the 21st century. This document provides districts with the procedures involved in the development and design of a system of technology to meet the program needs of the educational community.

The outcome of this document is to ensure that all new construction consists of:

A. backbone distribution system;

B. communications outlets in each room;

C. wiring closets.

New Jersey Department of Education

Take Me To . . .

Facility Standards for Technology in New Jersey Schools

SECTION ONE: EDUCATIONAL SPECIFICATIONS

I. THE DESIGN PROCESS

The design of the technology rich classroom in schools throughout the United States and Canada have been studied. There is probably no one classroom which offers the "right" solution. Key issues which must be considered when designing a classroom with information technology is changing teaching and learning modes of today and the future. Therefore, it may be necessary to design learning environments which are multi-purpose and multi-discipline and allow for a variety of activities, including class lectures, small group and individual work. Furthermore, combining classrooms into groups or clusters may suggest a diversity of spaces to be shared between classes. For example, four classrooms organized for project-based work may share a space for lecture and video presentation. In another situation, three classrooms may share a technology center which can be used by the students individually or by an entire class. Educational spaces may also reflect the multi-disciplinary nature of education today. Flexibility is key to the design to allow for change in use of information technology and changing teaching methods.

A. REFLECTION OF EDUCATION PHILOSOPHY

A building process is program-driven and has a philosophical base. Therefore, it is expected that the educational philosophy and beliefs as well as activities will be expressed in the design of the building.

The design process for a school building does not begin with drawings of plans but with the formulation of a building program that is the outgrowth of the educational specification, commonly referred to as "ed spec." The "ed spec" must convey all objectives to the design team in clear and unambiguous language. The components of Section Three deal with the spaces and activity areas, particularly with overall and specific features to be provided in each.

Basing their approach on the "ed spec" program requirements, the building design team seeks to find the optimal design solution through repeated feedback from the "ed spec" committee members and through refinement of the proposed plans.

The physical interpretation of intangible program requirements is at the heart of the architectural design process. As such, nothing in this guide is intended to be prescriptive or restrictive. This guide should provoke thoughtful consideration of needs and requirements. It is to be hoped that the ensuing dialogue will encourage innovation and vision that confirm the "ed spec" program requirements resulting in an appropriate building design.

B. MEETING STATED OBJECTIVES

The "ed spec" development process varies among educational agencies as does the composition of the groups charged with producing them. Those charged with producing educational specifications should have as their goal a school facility that meets all stated objectives. It is up to the architects' professional skill to accommodate this specification.

In the final analysis, *it is the educators*, not the architects, who have the responsibility for managing instruction. Since it stands to reason that facilities have the power to effect a learning environment and influence teacher and student behavior, educators must not delegate critical program decisions to architects. However, the responsibility for shaping those decisions rests with the architects.

Those charged with the preparation of the "ed spec" must, therefore:

Establish and define the educational philosophy, curriculum needs, student characteristics, instructional methodologies, and the part technology will play.

Base space and physical relationships of activity areas relating to the educational philosophy.

Decide on the spatial requirements for all areas. The requirements are determined by instructional methodologies, student characteristics, electronic technology, and furnishings.

II. THE REVIEW PROCESS

Develop a facility design from inception to completion in compliance with local and national building codes, life safety codes, health codes, and handicapped access codes. Consult with the local fire marshal for interpretations of local and state fire prevention code requirements. Architects, engineers, and select local education agency staff should know codes applicable to their respective responsibilities.

Designate a place in the local school district's office for storing educational specifications and construction contract documents, including "as-built" drawings and electronic technology systems documents. Every school should have a set of its own construction documents. They are needed to provide immediate access to the design and construction date not otherwise readily available.

III. ORGANIZATION OF THE EDUCATIONAL SPECIFICATION

The following is a uniform procedure for submission of the educational specification to the Department of Education, Educational Facility Planning Services, for approval of school construction projects as required by N.J.A.C. 6:22-1.2.

A. DEFINITIONS

Educational specifications for building construction or modifications are statements which specify to an architect what is required of a proposed educational facility. They serve as the link between the educational program and school facilities. Keep in mind that the educational program drives the shape of the space. The school district must thoroughly define its educational program so that the architect can design a facility to meet its needs.

B. REQUIREMENTS

Educational specifications shall be:

Submitted for the type of construction work outlined in the facilities section of the current code;

Prepared in writing and detail all the facilities considered for the construction program; and

Contain a cover sheet explaining the reasons for and nature of the building program.

Approval of education specifications is required prior to the submission of architectural schematic drawings. Do not submit educational specifications concurrently with architectural drawings.

C. EDUCATIONAL SPECIFICATIONS FOR INDIVIDUAL SPACES

Educational specifications for individual educational spaces can be broken down into various elements which can be addressed separately. The following are the required educational specifications elements for new construction:

Educational specifications for individual educational spaces;

Narrative descriptions for spaces other than educational spaces;

Narrative description or graphic representations of other details that will aid the educational consultant in the evaluation of the educational specifications.

For new construction, the educational specifications must contain an enrollment projection which forecasts the school enrollment by grade for the next five years and identifies the method of projection by the "cohort method." Educational specifications for other types of construction should be submitted with the same elements as described above.

D. FORMAT FOR EDUCATIONAL SPECIFICATIONS

A format which will guide the school district in the preparation and submission of educational specifications for individual education spaces is attached (Appendix A). The specification should clearly delineate the educational programs to be housed within the facility. It must clearly identify the functions as well as the methodologies involved in the teaching/learning process to be employed and the provisions needed for necessary flexibility when subject and content areas change. The educator must specify to the architect not only the type of spaces but the types of learning experiences to be conducted in these spaces. The specification can be used to define the educational requirements for individual educational spaces, and non-educational spaces such as administrative offices, teacher lounges, health services suites, food services offices, etc.

The following should be used as a guide in preparation of the Educational Specifications Form (in Appendix A):

PART ONE - GENERAL INFORMATION
County, School, School District
Type of Space

Former Use of Space

PART TWO - PHYSICAL SPECIFICS

Number of Students
Number of Instructors
Number of Similar Spaces
Spatial Relationship

PART THREE - DESCRIPTION OF INSTRUCTIONAL ACTIVITIES

Identify all pertinent instructional activities that will have an impact on space. The description of instructional activities should be written in narrative form and not in one or two word descriptions, because an architect cannot determine the type of activities to take place from one- or two-word descriptions. Keep in mind that similar programs are not taught the same way.

Listed below are some instructional activities. See Section Three of this document for more details.

lecture/media presentations
discussions
small group activities
computer based instruction
interactive video instruction
independent study
testing and evaluation
group interaction
teacher/student discussions
cooperative learning
peer tutoring
home room activities, etc.

Describe these activities sufficiently so that the architect will understand the educational parameters and classroom dynamics in order to properly design the facility that meets the district's needs. The job of the educational consultant in the Office of Finance, Educational Facility Planning Services is to ensure that all education specifications adequately describe the district's needs and can be translated into an architectural plan.

PART FOUR - SPECIAL FEATURES

Identify all the special features required to properly conduct the intended educational program. Special features can include such items as:

special lighting for auditorium and broadcasting studios
computers and associated computer equipment
carpeting
special paint colors
marker boards
special acoustical treatment
special ceiling treatments
ability to view other classrooms or educational spaces from the educational space in

question
special equipment for libraries and media centers
special furniture to suit educational needs such as
partitioned seating for small group instruction or special study areas, etc.

Specific sizes for furniture and equipment are not required. You must identify your needs; the architect cannot do it for you.

SECTION TWO: GUIDELINES FOR EDUCATIONAL TECHNOLOGY

I. MODERNIZING LEARNING ENVIRONMENTS WITH EDUCATIONAL TECHNOLOGY

A. RECOMMENDED GUIDELINES

The purpose of this document is to establish standard technical recommendations for networking voice, video, and data in New Jersey educational facilities. Use these guidelines to design power requirements and assist in the installation of communication cables. The design should reflect the needs identified in instructional technology plans, administrative technology plans, telephone systems, environmental systems, security systems, fire alarm systems, and intercom systems. (Refer to Appendix B). The guidelines propose a flexible communications network which accommodates current technologies and provides for future expansion without having to begin all over again.

The following recommendations allow for maximum technical capability within a cost-effective framework and a reasonable facility life. Although certain network criteria are required, the guidelines are not intended to be prescriptive or restrictive. The guidelines should provoke thoughtful consideration of each school's individual layout and encourage innovation and vision.

Following the guidelines will assure quality communication network installations for both newly constructed and existing educational facilities. The general recommendation is that every educational facility develop, as an absolute minimum, a multi-use communication network. This communication network should enable students, educators and members of the community to take advantage of the many resources offered by a technologically advanced learning environment.

The guidelines recommend that all schools design well-documented plans and specifications with appropriate approvals. It is also recommended that schools participate in continual testing/evaluation of the communications network as well as develop procedures for staff training. This can be coordinated with assigned vendors and manufacturers.

B. OVERVIEW OF TECHNOLOGY MODERNIZATION

The intent of technology modernization is to provide communication system support facilities that meet the instructional needs of schools, provide for a quality installation that is aesthetically consistent with the classroom environment, is adaptable to future needs, and is well documented to provide for convenient, effective administration and maintenance of the networking system. In order to achieve this task in existing school facilities, it is necessary to examine retrofit

designs based on overall feasibility and trade-off studies that include all major building components in existing facilities. All of the recommendations presented in the guidelines apply to both new and retrofitted facilities, however, special attention must be given when examining retrofit designs.

The design for a communication network identifies the wire distribution system and the type of communication cables as primary technical resources. It is recommended that the wire distribution system include a Communications Equipment Room (CER), Communications Closets (CC), and Communications Outlets (CO) as the physical connectors of information exchange.

a) The Communications Equipment Room houses all or most of the head-end source equipment and injects source information into the wire distribution system. At least one Communications Equipment Room is recommended in each facility.

b) Communications Closets represent the physical connections where information is received from the Communications Equipment Room and then released via the wiring distribution system to the Communications Outlets in individual rooms. Each educational facility must construct a space to house at least one Communications Closet per floor.

c) Communications Outlets, which differ from power outlets, are generally designed to receive multi-cable signals and to provide access directly to the user. Communications Outlets and power receptacles should be installed within six to eight feet of every workstation to preclude the use of extension cords and extension communication cables.

The communications cables selected for both new and existing facilities must support the requirement of networking voice, video, and data media sources. They should be capable of handling interactive multimedia for interactive distance learning. In order to meet this need, a combination of copper wiring, coaxial cabling, and fiber optics are recommended throughout the wire distribution system. For instance, each classroom and administrative area should receive full telephone capability via the wire distribution system. Accordingly, the wire distribution system shall support the installation of a standard Local Area

Network (LAN) system such as Ethernet, Token Ring, 10-Base-T, etc. (Refer to Appendix D) The minimum speed rating of the wiring distribution system support apparatus should be 100 Mbps.

Detailed documentation of the installed wiring distribution system must be provided by contractors. This is necessary to facilitate system administration, system maintenance, and future system changes. System documentation must include as-built drawings, detailed cable drawings with all cables and terminations identified, bill of materials of all installed equipment and wiring, rack or backboard equipment layouts showing placement of support equipment, specifications with appropriate approvals for connectors and cables, as well as the model make and serial numbers of installed equipment. No changes or modifications will be made at any time without adding appropriate changes in this system documentation.

System test and performance verification must be provided by the contractor after system installation and prior to system acceptance by a school. Training must be provided by the contractor to designated school personnel on the operation, administration, and maintenance of the wiring distribution system and support electronics.

II. STANDARDS

A. COMPLIANCE CODES

NJAC 5:23
NJAC 6:22
NJSA 18A
BOCA National Building Code
BOCA Mechanical Building Code
NEC (National Electric Code)
NFPA (National Fire Protection Association)

B. ADDITIONAL STANDARDS AND REFERENCES

EIA/TIA-569- Electronic Industries Association/ Telecommunications Industry Association Commercial Building Standard for Telecommunications Pathways and Spaces

Electronic Industries Association/
Telecommunications Industry Association
2001 Pennsylvania Avenue
Washington, DC 20006

EIA/TIA-568-A - Electronic Industries Association/ Telecommunications Industry Association Commercial Building Telecommunications Wiring Standard

Electronic Industries Association/
Telecommunications Industry Association
2001 Pennsylvania Avenue
Washington, DC 20006

LPC- Lighting Protection Code (NFPA-78)

IEEE 802.X - Institute of Electrical and Electronics Engineers LAN Standard for Ethernet

IEEE Service Center
445 Hoes Lane
Piscataway, New Jersey 08855-1331

UL Listed- Underwriters Laboratory Listed

Underwriters Laboratory
Corporate Communications Office
833 Pfingsten Road
Northbrook, IL 60062

ANSI- American National Standards Institute

ANSI
1430 Broadway
New York, NY 10081

ADA- American Disabilities Act

Office on the American With Disabilities Act
Civil Rights Division, U.S. Department of Justice
PO Box 66118
Washington, D.C. 20035-6118
(202) 514-0301 (voice)

(202) 514-0381 (TDD)
(202) 514-6193 (E-mail)

III. DESIGN APPROACH

A. COMMUNICATIONS EQUIPMENT ROOM (CER)

A Communications Equipment Room (CER) is recommended for every building because the CER is the entry point for communications systems into the building. It houses the head-end equipment of the school's communications systems and is connected via cabling to Communications Closets for horizontal distribution to the end user. Additionally the CER might house gateways, tuners, video cassette recorders, audio and video distributions systems, mainframes, etc. System documentation and test equipment may also be housed in the CER. (See Appendix E, Figure 1.)

The CER also functions as the demarcation point for external systems such as telephone company lines, cable television system connections and fiber optic cables, and contains termination hardware for these systems. In retrofitted facilities, flexibility must exist for the specific head-end equipment stored in the CER. The CER may also house file servers or mini-computers for the data systems or be the point where servers are connected to facility cabling. In addition, CER could act as the source for delivery of communications to other buildings.

If a CER cannot be provided, a Communications Closet can be used to perform the termination and cable distribution function of the CER. In this case, the Communications Closet functions as the origination node for the horizontal distribution system and houses the head-end equipment.

Primary considerations for CER development include environmental conditioning, power, security, and access by operational and maintenance personnel. The following must also be taken into consideration:

The CER must be uncluttered and contain adequate provisions for the equipment and documentation that cannot be housed in the Communications Closets.

Lighting requirements of 50 - 70 footcandles measured three feet above the finished floor.

An environmentally controlled atmosphere is required. The ambient room temperature in the CER must be maintained between 40 degrees F and 80 degrees F. Relative humidity should not exceed 60 percent if the CER contains active equipment. Required cooling must accommodate an internal 50 watt per square foot heat load generated within the CER.

An adequate and uninterruptable power supply is needed for the vitality of the CER. Minimally, a double duplex receptacle shall be installed on each of the three walls (excluding the door wall) to power the CER equipment and test equipment. All receptacles shall be double duplex, isolated ground receptacles and must be wired (line, neutral, isolated ground) to the power distribution panel. Each of the double duplex receptacles must be on its own 20 ampere circuit breaker from the primary power source.

It is important to provide a ground for the CER because computer networks and other technology equipment may provide ground paths over which electrical noise and spikes

might be transmitted and interfere with the operation of the equipment. To ensure proper wiring a review of the facilities entire electrical grounding situation can be conducted with an electrical engineer.

Surge protection is required in the CER and all CCS's. No transformers utilizing more than 220Vac should be co-located in these spaces. Surge Protection should be provided at all power and signal entries to the building. If this is not possible on the power circuits, it must be provided at the disconnect panel or panels providing power to technology areas and equipment. Additional surge protection must be provided at all power receptacles serving computers, printers, data equipment and technology systems. This can be done by attaching surge protection equipment to the desks, workstations, or adjacent walls.

Non-conductive fire suppression and smoke evacuation systems are recommended. If local code requirements are more stringent, they take precedence. Electronic microprocessor-based fire/life safety systems may be considered.

The location of the CER in the school must not be near water pipes, or below rest room facilities. No plumbing activities should occur in the area of the CER.

A security system should be considered for the CER. Detection systems and electronic microprocessor-based security systems are two choices for security control.

All cabling and head-end equipment in the CER must be permanently labeled, identifying the origination point. System documentation and detailed cable drawings representing the CER might be provided to each school facility.

The size of the CER will vary depending on the quantity and types of communications to be delivered to the user area. Its size is also a function of whether or not the school is a retrofit model or a new construction. Square footage may vary between 150 and 500. CER size requirements should not only have adequate space for existing needs but also allow space for future expansion.

EIA/TIA 569 provides good guidelines for CERs and CCs.

CERs may also double as CCs and feed work stations located within 290 feet.

B. COMMUNICATIONS CLOSET (CC)

Communications Closets (CCs) act as the distribution point for communications cable either to the end user or to communications outlets in other/additional user areas. Therefore, the wiring distribution system must support cabling from the Communications Equipment Room to the Communication Closets. The CCs should be centrally located near user areas and connected to user areas via cable runs of no more than 290 feet. The number of CCs is a function of the number and distance of user areas. However, there should be a minimum of one CC per floor. Additional CCs may be required if cable horizontal distribution exceeds 290 feet.

The Communications Closets house cable intermediate distribution frames and termination equipment used to provide signal distribution to the Communication Outlets and routing equipment. (Refer to Appendix D)

Convenient access should be provided in the CC for performing system administration and

maintenance. The CCs must not be located near water pipes or below rest room facilities. The CCs must not serve as a janitorial or storage room.

A Communications Closet may serve the function of a CER if source equipment is limited and can be accommodated in the CC. If a CC does not exist on the floor where facility wiring is installed, one may be constructed in a room that is serving another primary function such as a user area. A convenient location for this construction would be in the corner of a room.

Mechanical and electrical requirements for a Communications Closet include the following:

Lighting requirements of 50 - 70 footcandles measured three feet above the finished floor are recommended. Non-EMI generating lighting should be installed.

As with the CER the CCs require an environmentally controlled atmosphere to maintain an ambient room temperature of 40 to 80 degrees F. The relative humidity of the CCs should not exceed 60 percent. If the CCs have active equipment, the required cooling must accommodate an internal 50 watt per square foot heat load generated within the room.

An adequate and uninterruptable power supply is needed for the vitality of the CC. Installation should include a double duplex receptacle on each of the three walls (excluding the door wall) to power the CC equipment. All receptacles shall be double duplex, isolated ground receptacles and shall be wired (line, neutral, isolated ground) to the power distribution panel. Each double duplex receptacle shall be on its own 20 ampere circuit breaker from the primary power source.

It is important to include isolated ground for the CC, because computer networks and other technology equipment may provide ground paths over which electrical noise and spikes may be transmitted and interfere with the operation of the equipment, A review of a facility's entire electrical grounding situation should be conducted with an electrical engineer.

Surge protection is required in the CER and all CCS's. No transformers utilizing more than 220Vac should be co-located in these spaces. Surge Protection should be provided at all power and signal entries to the building. If this is not possible on the power circuits, it must be provided at the disconnect panel or panels providing power to technology areas and equipment. Additional surge protection must be provided at all power receptacles serving computers, printers, data equipment and technology systems. This can be done by attaching surge protection equipment to the desks, workstations, or adjacent walls.

Non-conductive fire suppression and smoke evacuation systems are required as per national BOCA guidelines. If local code requirements are more stringent, then they shall take precedence. Electronic microprocessor-based fire/life safety systems may be considered.

The location of the CC in the school must not be near water pipes or below rest room facilities. No plumbing activities should occur in the area of the CER or CC.

A security system should be considered for the CC. Detection systems and electronic microprocessor-based security systems are two choices for security control.

All cabling and head-end equipment in the CC is required to be permanently labeled,

identifying the origination point. System documentation and detailed cable drawings representing the CC must be provided to each school facility.

The size of the CC will vary depending on the quantity and types of communications to be delivered to the user area. Also, it is a function of whether or not the school is a retrofit model or a new construction. Square footage may vary between 50 and 120.

EAI/TIA 569 provides good guidelines for CERs and CCs.

CERs may also double as CCs and feed work stations within 290 feet (due to connecting cables at each end).

C. BACKBONE DISTRIBUTION SYSTEM

The backbone distribution system design includes the requirement to support the networking of voice, video, and data from the Communications Equipment Room to the Communications Closet (or end user if no intermediate distribution is required). (See Appendix E, Figure 2 and 3.)

The structural design of school buildings effects the location of cable systems. New building construction should be designed to accommodate and anticipate current and future technologies. Concrete floor slabs on grade should be designed to accommodate cables and wires. In retrofitted facilities, it is advisable to review available above-ceiling space for wiring systems. Surface mounted cables and wires are likely to provide the desired flexibility at lower cost. If this is done, attractive and maintenance-free designs for raceways should be used. As an alternative, the facilities plan may include cable and wire conduits. It must be emphasized that signal wires should not be placed in the same conduit as power wires. Additionally, all cable ways must accommodate advanced technology cable requirements such as the minimum bending radius for fiber optic cable.

Fiber is the preferred cabling for school backbone interbuilding and intrabuilding wiring due to its large bandwidth capacity and extended distance capacity. Moreover, fiber optic cable is not susceptible to noise or electrical interference. As a minimum, backbone and vertical riser cables shall contain 12 fibers (multi-mode 62.5/125 microns). All fibers in each cable must meet EI standards. Intrabuilding wiring includes all cables between the CCs and CER and vertical riser applications. Any intrabuilding fiber optic cabling not installed in conduit

shall be plenum rated and meet NFPA and UL standards. To connect CCs in multi-Category buildings, a riser rated cable must be installed. Interbuilding, or between building, fiber optic cable must be rated for outdoor use and composed of dielectric materials.

Coaxial cables are critical in the backbone distribution, due to their capacity to host a wide variety of educational technologies. Type and size of cable will be dependent upon hardware. A combination of coaxial and fiber cables are highly recommended for the facility backbone.

Metallic cabling for interbuilding wiring is acceptable if lightning protection devices are used at both ends of the cabling provided the cabling meets system performance characteristics and provided it is significantly more cost effective.

A combination of fiber and copper cables may be a cost-effective alternative. Multiple pair

copper cables gauge to support applications should also be considered. They should be sized to support the number of proposed work stations in a given area - e.g. 1 pair per telephone line for analog and 2 pairs per telephone line for digital. The recommended size is 2.5 pairs per voice work station. The .5 is a growth factor. Recommended copper cables are unshielded twisted pair wiring, #24 AWG certified as a minimum Category 5 suitable for 100 Mbps data operation and Category 3 for standard telephone communications.

In order to remain flexible for future technical considerations, the guidelines acknowledge wireless cable transmission as a Local Area Networks (LAN) technology, and Asynchronous Transfer Mode (ATM) and Integrated Services Digital Network (ISDN), as Wide Area Network (WAN) technologies. However, current technical usage reveals that these are not preferred solutions for backbone network design, due either to expense or limited bandwidth.

The recommended distribution of the wiring system for the backbone network is a ceiling raceway. However, for retrofitted facilities, other wiring alternatives do exist such as underfloor, underground, and overhead.

D. HORIZONTAL CABLE DISTRIBUTION SYSTEM

The horizontal cable system connects voice, video, and data from the Communications Closet to either the end user directly or Communications Outlets in user areas. The components of the system include coaxial cables, Category 5 copper data cables and Category 3 copper telephone cable. (See Appendix E, Figure 4, 5 and 6.)

Unshielded twisted pair (UTP) with a 24 AWG is acceptable as a horizontal wiring system from the Communications Equipment Room (CER) or Communications Closet (CC) to the Communications Outlet (CO) in the end users' area. The UTP cable used must be manufactured to operate at 100 Mbps data speeds and be certified UL Category 5 or EIA/TIA Category V. The UTP cable used must meet National Fire Protection Association (NFPA) and Underwriters Laboratories (UL) standards and be marked Plenum.

The recommended horizontal wiring distribution system must provide end-users access to, at least, one coaxial cable, four pairs of Category 5 copper data cables and four pairs of Category 3 copper telephone cables. These cables will be pulled together and terminated at each communications outlet. Copper cabling for telephone capability and the coaxial cables can be terminated at each communications outlet in the user area. Advances in UTP technology have shown that video systems that run on coaxial cable may also run on UTP. Consideration may be given to run one Category 3 and two Category 5 cables in lieu of coaxial.

Fiber optic cables are currently an alternative wiring system for horizontal intrabuilding distribution between Communications Closets and Communications Outlets. Due to cost effectiveness, system speed requirements, cable length requirements, and cable quantity considerations, installation of at least some fiber optic cable is preferred. Generally, the inclusion of fiber enables school administrators to better prepare for future educational applications, e.g., computer labs or high concentration of stations.

The basic parameters of wiring systems specified in these guidelines have been established through requirements and recommendations of the Institute of Electrical and Electronic Engineers (IEEE), American National Standard Institute (ANSI) and EIA/TIA 568. All products used in new or retrofitted facilities must be UL listed and meet FCC specifications.

E. COMMUNICATIONS OUTLET (CO)/END USER

The Communications Outlet refers to the connection point between the horizontal cable and the terminal devices such as work stations in the user area. The Communications Outlet differs from the power receptacle, therefore the two may be color coded differently. Both types of outlets must be conveniently located to the end user.

Each work station in the user area shall have a Communications Outlet within six to eight feet of the work station. Every user area should include a minimum of two Communications Outlets and two power receptacles. Depending on the instructional needs of the user area, it may be necessary to require two or more COs and power receptacles. Note that future changes in the use of an area may require additional outlets, thus eliminating the flexibility to expand. All communications outlets should be equipped with a surge protection device connected between the power receptacle and the computer or peripheral.

Communications Outlets include baseplates in user areas. The design of the baseplate must consist of enough jacks to accommodate the specific terminating cables, such as telephone wires, data cables and coaxial wires. The applications and number of jacks are determined by the type of cable and the connection made at the CER or CC.

All cables, both communications and power, must be identified and labeled at the origination point in the communications outlet and power receptacle. The outlet end shall be identified as to its location and the source of the cable.

SECTION THREE: AREAS OF ACTIVITY

I. NEW ROLE OF SCHOOL

A. TRADITIONAL LABELS

Traditional labels for a school's activity areas may no longer be appropriate. The traditional groupings may no longer be acceptable in cases where instruction and classroom management are supported by a technology infrastructure. It is not only appropriate but desirable to think nontraditionally when planning "technology- friendly" spaces.

The school as a place for six to eight daily hours of instruction belongs in the past because many communities now demand telecommunications and physical access before and after normal school hours. Instructional Media Center (IMC) services and the facilities for occupational education are among those in demand. School facilities are needed for such services as day care for children with working parents, adult education (including programs for completing high school), evening meetings and special programs by a variety of community groups.

Therefore, schools must be planned for twenty-four hours a day operations. At any time voice systems can link callers with recorded information, video systems can transmit school-related items to home television or computer monitor screens, or video phones be they POTS or digital and modem-equipped computers may access many of the school's data systems. This new role of the school has a profound impact on security and classroom design and will affect the way buildings are planned.

A full-time staff person is needed to support the increasing levels of technological complexity and provide assistance in its use as an instructional and management tool. In larger schools this is an in-house service, but all schools should, at the very minimum, be able to receive support and assistance on an on-call basis at the local school district level.

Those persons responsible for developing educational specifications must be able to anticipate problems related to technology. This requires understanding the functional needs brought about by new technology-supported teaching.

Knowledge and experience of the following is required:

Various facility-related problems that teachers, staff, or students may encounter with information technology.

Activity areas that may require electronic equipment.

Methods of guiding staff and teachers toward some of the activities that should take place in technology-supported spaces.

B. IDENTIFYING ACTIVITY AREAS

Electronic linkage of curriculum areas fosters a new level of flexibility among space assignments. As a result, activity areas are not limited to spaces dedicated specifically to instruction. Activity areas should be identified and each one could include one of the following major groupings commonly found in all elementary and secondary schools.

Administrative Offices	Instructional Support
Guidance	Instructional Media Center
Health	Support Services
Instruction	Security

Under the grouping of Instruction are sub-headings such as School to Work Initiative, Art, Music, Physical Education, Science, Special Education and others.

Spaces traditionally exempted from activity area status, and usually not part of construction specifications, include certain support spaces, such as mechanical and boiler rooms, workrooms and custodial facilities associated with them. However, because of increasingly sophisticated building controls, ALL areas should be part of a comprehensive educational specification.

Another specific area is the communications equipment room, a space set aside for communications equipment.

II. SPECIFIC AREAS OF ACTIVITY

A. ADMINISTRATIVE OFFICES

The administrative offices are the nerve center of the school. It is the point of contact between the school and the community and its services, such as police, fire and rescue departments. The

design and technology for this center must support the school's operational plan, whether centralized or decentralized, as well as meet the needs of students, staff, parents, and community members using the school's services.

The operational plan must be designed to support and link all school programs and satisfy all information management needs. The following should be considered in planning:

Immediate access to student records and emergency data must be provided to staff. Sufficient terminals and keyboards will allow simultaneous clerical use of equipment.

Provide multiple phone lines for school-parent communication. Staff must be able to send data system-based information to student homes.

General public information access must be provided 24 hours a day.

The type of voice systems that best meet the needs of the school should be spelled out.

Data relating to attendance, maintenance, scheduling, and student services may originate from multi-media workstations anywhere in the school building. Direct links must be provided to the administrative offices.

Administration and staff should have teleconferencing capabilities with other schools and other locations.

Administrative staff should be able to communicate with each other and key building personnel throughout the building.

Administration and staff should have telecommunications capability at home to enable them to access and monitor school information and controls.

Work space must be provided for all staff for planning and maintenance of electronic information.

Computers should be located at all teachers' desks with access to an administrative mode and connections to printers.

Fax machines or integrated fax-modems in computers should be provided for staff.

Facilities and technology must be provided for all staff for the production and reproduction of printed materials, including official correspondence.

Facilities must be provided for electronic storage and retrieval of information for all staff. Fireproof storage should be sufficient to

accommodate program disks and various backup and duplicate material. Backup copies of permanent records must to be stored in a fireproof location or a separate building location for safety.

Video surveillance should be provided for security purposes.

Consider providing headsets matching the phone system for clerical staff who need to work

with both computers and telephones simultaneously.

B. BUILDING AND GROUNDS SUPPORT

The maintenance and operations of school facilities offices must keep records and communicate large amounts of data not just for maintenance and operations, but also environmental, Public Employee Occupational Safety Health Act (PEOSHA) and other worker protection laws that have been enacted. The following should be considered in planning:

Computers are required to log data automatically and also permit keyboard and voice entry.

The equipment must have an auxiliary power supply and data back up capabilities in the event of power failures.

Operation should be limited to trained school personnel such as head custodian, boiler operator and faculty as necessary.

Provide the necessary work station, telephone and data transfer line.

Data transfer is linked via modem to a central monitoring station at the districts administrative office and/or to a vendor monitoring various operating systems of the building facilities.

Data compiled facilitates will be used in the budgeting process for the following areas:

Energy management of Heating, Ventilating, and Air Conditioning (HVAC) equipment
Fire alarm system
Intruder alarm system
Kitchen equipment, temperature sensors
Repair and replacement requests
Meter readings - water, natural gas, electric, fossil fuel
Gasoline pumps - record all fueling for districts vehicles
Lighting management
Air quality monitoring
Monitor flow switches or valve for leakage detection in sensitive areas.

C. SECURITY

Technology equipment should be networked and made part of a security network system that deters breaking and entering. Where necessary, devices can be installed to attach equipment to surfaces.

The security system should be computerized with a central base within the building. A sensory alarm system for nights and weekends could be included with electronic connections to local authorities. An option could be a monitored surveillance system.

The electronics and wiring must be appropriate for the size of the building and the amount of equipment needed for each site; local codes must be adhered to.

D. FOOD SERVICE

The modern school food service provider must maintain and communicate a wide variety of data to facilitate the traditional function of providing food service to all populations of the school. Students should possess magnetized ID cards used to monitor and record eligible school lunch purchases. Students would validate their cards by entering their pin code. Please note: The same card, referred to as "smart cards," could also be used on school buses and for checking out media materials.

The electronic technology located in the food service area will collect and compile data as prescribed by state and federal regulations under entitlement legislation on behalf of the school and its population.

Consider computerized cash registers that can supply information directly to the local school district's accounting system. Locate them at the end of each serving line.

Consider providing the food service manager's office with computer access to information that will help anticipate requirements for making weekly food purchases through the local school system.

The food service staff, by providing accurate and timely data to the county or city office could facilitate planning the following year's budget. The following are information needs:

Proper point-of-service (POS) identification of all eligible meal reimbursements.

Evidence that federal requirements are met: all meals contain required components, and eligible recipients are limited to one reimbursable meal.

POS terminals that are linked to one on-site computer with on-line processing during meal service can record all transactions. These data will then be transferred to the school system's food services office.

Capability to process applications, utilize direct certification, maintain data, and print eligibility lists.

Meeting point-of-service and eligibility requirements for federal regulations.

E. GUIDANCE

Technological applications for the guidance office are tied to several administrative applications such as scheduling, registration, records, and attendance. Guidance applications should be included in the school-wide local area network (LAN), not just in the LAN dedicated to that office.

In addition to work stations for counselors and guidance staff, terminals are required for student use in an outer office/reception area. This is needed because major guidance applications address information for students as well as information about students.

The following should be considered in planning:

Provide appropriate software and video to support guidance activities.

Provide sufficient electrical power to support multi-media workstations and their capacity.

Provide student-use work stations in the outer office that are equipped with a video cassette recorder (VCR) and/or compact disk player, in addition to a computer and printer. Provide enclosures for equipment.

Provide access to high quality printers for the staff.

Provide a reader/scanner for the processing of career assessment inventories, surveys, referral dispositions, etc.

Provide access to World Wide Web (WWW) or other real time information sources and e-mail for communication with colleges' and universities' admission offices.

Provide hardware and software to allow an automatic phone caller for communicating and receiving information with voice mail to and from parents on a 24-hour basis.

F. HEALTH

The health suite provides first aid, health counseling and dispenses prescribed medications. It must provide a safe and private area for handling health issues and a secure place for maintaining health records.

The health suite should preferably be located on the ground floor, adjacent to the administrative offices and guidance, with easy access to automobiles and ambulances. The suite should be linked to the other offices by telephone, including an intercom, and a security system.

The following areas should be addressed:

Provide electrical outlets in suitable locations for medical equipment such as diagnostic tools and digital thermometer.

Provide the school nurse with a computer terminal.

Provide a telephone for use by the nurse and students.

Provide linkage to the administrative/guidance computer network.

G. GENERAL INSTRUCTIONAL AREAS

The instructional general areas, defined for the purposes of this section as the classrooms, seminar rooms, and laboratories, are the focal point of the school. Students and teachers spend most of their time in these areas.

Technology used to support instruction may include, besides the obvious software and computers, items such as laser and compact disk players, probe devices, modems, desktop video conferencing and other interactive technologies.

The technology used in these areas must support the instructional program. The technology

should allow for more efficient use of student learning time. The technology must also address the administrative responsibilities of the teacher in order to minimize time spent on non-instructional activities.

1. **TEACHER-FOCUSED TECHNOLOGY**

There should be:

Computers should be linked to the administrative suite for registration, attendance, and record keeping.

The capability to create computer generated instructional materials should be provided.

Computers should be connected to local and global resources for direct access to information.

There should be multimedia access for teachers with the capability to display images to the entire class.

There should be the capacity for storing school district pupil data and the ability to access it.

A security system should be provided for teachers' work.

Provisions for the sharing of human resources via modems or desktop video conferencing should be considered.

2. **STUDENT-FOCUSED TECHNOLOGY**

There should be:

Computer access to instructional materials centers from within each classroom and, on a 24-hour basis, to information within the school.

A sufficient number of networked computers for students to use at any time.

Access to distance learning technologies (including Internet access), interactive videodiscs, compact disks, high-quality printers, multi-media workstations desktop video conferencing for virtual classrooms and instructional television, with the capability of videotaping TV programs and classroom sessions.

Adequate technology support for all students.

Computer monitors that are the appropriate size and resolution for the activity.

Observance of computer ethics and copyright laws and regulations.

Security systems for protection of student work and any other activities.

Computer hardware and multi-media workstations that accommodate the disabled.

The changing environment of technology-driven instruction and the proliferation of computers demand a generic classroom design. These multi-purpose, multi-discipline classrooms must be flexible enough to accept multi-media support of instruction from any place within or from outside the classroom. The space must lend itself equally well to the placement of furniture and equipment in support of "traditional technologies," to new demonstration techniques and different ways of working.

This change further suggests that a small (shared) teachers' office between their respective classrooms be provided.

The following are recommended in the general instructional areas:

The teacher command center should always be positioned in the best location for the teacher and multimedia support of instruction.

The classroom should contain a multimedia computer station with high speed data and video access complete with a projection system and printer capabilities. The power cord should reach the nearest power source (on a dedicated circuit) without extensions.

A television receiver should be available in every classroom.

Every student in the classroom should be able to comfortably view the projected programs. To effectively reach all students, a minimum of two receivers with a 25 - 27 inch screen is recommended. The receivers should be permanently mounted on carts, wall or ceiling. They should be low enough to allow reach of the controls and attachment ports. Large rear screen projection sets with closeable doors to protect the screen surface may be an option. Another option could be a monitor projection system that would enable the labs to be connected without having to dim the lights, this is especially effective for the deaf.

The classroom should accommodate the use of a mounted camcorder to project and record visuals and demonstrations.

If LCD or overhead projection systems are used, make provision for a (ceiling track-mounted) pull-down screen because computer images projected on walls lack clarity. Use a 4 x 5 ft. clear, white, and absolutely smooth wall surface only as a last resort.

Allow space for a ceiling-hung projection unit or large screen monitor.

Provide secure storage areas for manuals, programs, software, printing paper, blank disks, copies of various programs for student use, and other miscellaneous supplies.

Computer clusters or mini-labs could be based on curriculum requirements.

Locate the computer mini-lab in shared spaces within activity areas, outside the traffic flow and out of the sight lines of students. This will allow other instructional activities to occur simultaneously.

All computer stations in secondary school classrooms must be provided with space for bookbags, personal effects and sufficient writing surface. Tables and multi-media workstations that accommodate wheelchairs should be provided.

Provide marker boards and "liquid chalk" markers in lieu of chalkboards. Computers and other electronic equipment can be rendered inoperable by chalk dust.

Provide communication outlets to connect computers to the building-wide network. Provide outlets for printers and other peripherals. Group the outlets for computers, standard power, television, and a modular telephone jack convenient to the teacher's command center.

Provide conduits and outlets in computer mini-labs as required for planned technology and for potential additional equipment. Wall outlets should be at counter or desktop height. Television outlets and telephone jacks should be accessible from the teacher's work areas. (See Communication Outlet in Section Two). In the design process allow for future expansion.

Allow for control of ambient lighting to avoid glare on monitor screens. Decrease glare on the monitor screen to reduce eye strain.

H. SCHOOL TO WORK

In the occupational education program, classrooms and labs should replicate industry-specific state-of-the-art technologies and, where possible, look toward the future. They should reflect, as nearly as possible, the environment that students can expect to find in a changing and dynamic world of business, construction, and service industries. This may require special-equipment laboratories for example: computer aided design (CAD) and computer assisted manufacturing (CAM) labs.

The following issues should be addressed:

Provision of computers for competency-based instruction.

Provision of computers for inventory maintenance of materials, supplies, and equipment.

Provision of computers for maintaining student data.

In addition to the suggestions and recommendations for the Instructional Classroom, the following should be addressed:

Provide teachers with places for multi-media support of instruction.

Provide a locked storage area for software and electronic hardware. This area can be part of IMC storage or located in the instructional area.

Reduce the amount of airborne particulate matter where magnetic tapes, disks and dust-sensitive equipment are stored. Consider filters in air handling ducts and maintaining positive air pressure in the space.

Business education labs should be equipped with one computer per student. The number of computers and printers should be sufficient to accommodate the maximum class size.

The graphic arts lab could also be used for the occupational education curriculum.

Consider revamping home economics laboratories into multi-purpose labs to facilitate integrated learning.

Classrooms and labs should be provided with outlets for a wall-mounted large screen television or monitor and a dedicated line for the teacher's telephone and modem.

Provision should be made for high speed digital (ISDN) lines for connection to Internet and video conferencing.

Consider networking computers to provide for screen information sharing between computer monitors so that teachers and students can see each others work on their own monitors.

Locate classrooms for ready access by adult education and training programs.

Provide computer-aided design (CAD) equipment in drafting and machine tooling labs. Provide one computer per person. Adjustable shelves for keyboards are recommended.

Computer and computer-aided design users will shift their eyes from documents on multi-media workstation surfaces to monitor screens. Therefore, the finishes and coatings on walls, ceilings, floors and furnishings must be chosen to be within a moderate range of contrast and to be glare-free.

Consider maintaining areas that house computer multi-media workstations with positive air pressure. Provide well-sealed openings for a dust-free environment.

Provide special exhaust systems to remove chemical or particulate contaminants from labs and darkrooms.

Provide acoustic wall and ceiling surface treatments that serve to achieve acceptable background noise levels. Consider installing acoustic baffles in noisy areas, for permissible noise exposures.

I. ART CLASSROOM

The art classroom should accommodate computer art, e.g. computer-aided design, graphics and digitized photography for grades 6 - 12. A graphic arts laboratory, to be shared with technology education, may therefore be advisable. Consider the following items:

The classroom should contain a multimedia computer station with high speed, data and video access.

There should be color laser printers, high speed data connections, and a scanner that is capable of supporting sophisticated graphics software.

It is essential to locate all electronic technology equipment in a protected area, free from dust and away from water and heat. Provide dust covers for all equipment, including computer keyboards.

J. MUSIC

The music classroom must be designed to accommodate computer-aided music, instructional and sound producing systems. Classroom design must minimize sound transmission to adjacent spaces. Therefore, this classroom should be located away from instruction and support areas that require a quiet environment. The layout and design of music classrooms should minimize the impact of sound so that teachers are able to monitor small group activities while conducting class activities.

Consider the following items:

Electronic keyboard labs and synthesizers for the elementary, middle and high school years.

Computer-aided systems with sound boards for all levels. The midi- interface is recommended.

Installation of high-quality stereo systems with the capability to play compact disks, digital audio tapes (DATs), or other high quality analogue audio media.

Microphones in all music classrooms.

K. PHYSICAL EDUCATION

Physical education programs that include electronic technology are becoming a standard way for students to receive information and for teachers to instruct them in fitness and other programs. Technology can also assist the teacher's in the performance of administrative duties that include recording fitness scores, performance tests, and grading.

With regard to teacher-focused issues, electronic technology should be employed to address those issues described in section G (General Instructional Areas). With regard to student-focused issues, most of those are also described in section G.

The following electronic technology-related issues must also be addressed and considered when planning:

An intercom system in all physical education teaching stations and locker rooms should be connected to the main administrative offices and health suites. This system should be a key-controlled secure system. It would primarily be required for emergencies.

One or more locations should be provided to students for access to multimedia computers capable of modeling and interactive instruction.

Fitness training technology (Nautilus equipment, stationary bikes, etc.) and technology for physical therapy should be tailored to the programs taught.

Video access must be a consideration in the teaching environment.

Physical education teaching stations where videotaping of students is likely to occur, must allow quality and ambient lighting levels that permit production of videotapes of a correct color. Videotaping students can take place during skill practice in various sports settings for later review and analysis by the learner and the teacher.

L. SCIENCE

Many innovative science programs irrespective of grade level require access to national telecommunication networks such as "Kidsnet," "weather satellite data," and others. Therefore, high speed data access is important.

With the aid of strategically placed electronic monitoring devices during construction, the school building itself can become a science laboratory.

Consider the following (to name a few):

Install a large observation window on an exterior or interior wall to the school's heating plant.

Color code the hot, cold and chilled water lines in visible areas throughout the building, including the heating plant.

Locate the monitoring diagrams for the HVAC and power systems where instruction about them can take place.

Build temperature and moisture sensors into the building structure to monitor the soil under footings and by walls at grade level, in exterior wall cavities, under roof decks, etc.

Locate barometric pressure gauges, anemometers and weathervanes in appropriate places with digital readouts in suitable instructional areas.

Probes measuring sound travel through building materials of various densities can also be installed during construction.

M. THE INSTRUCTIONAL MEDIA CENTER

School Instructional Media Center (IMC) are a critical element in the overall school's commitment to prepare students for the challenges and opportunities of the 21st century. These centers "embody the school's philosophy of implementing, developing, learning, enhancing, and promoting critical thinking skills, lifetime learning, and the basics of information literacy, writing, and computation in all formats, including print, multimedia, and technological resources."[1]

"An effective library information skills program is an integral part of the total educational program, teaching students the basic processing skills necessary to connect them with information and ideas in all subject and interest areas. Development of these skills involves the collaborative efforts of certified library media specialists, administrators, classroom teachers, technology coordinators, computer teachers, parents, and students as active partners in the educational process, thus reinforcing the value of literacy and life-long learning." [2]

The Instructional Media Center, provides materials in all formats to address divergent learning styles and abilities, functions as an extension of the classroom, and provides services to support the needs of the curriculum. Basic audiovisual, computer and telecommunications (telephone) and desktop video-conferencing distance communication technology should be included in every IMC. The very nature of the IMC provides the entire school community equal access to

all resources.

The IMC must also have the capacity for teaching students and staff how to use the equipment and access the information. It should also be a repository for master teacher tapes and exemplary student work that can be shared or used by others.

1. LIBRARY AUTOMATION

Technology provides for expanded resources and services to all students and broadens the application of services to include:

Networked software offering simultaneous access to a variety of resources.

Computers with the capability to run single user CD-ROM's (either stand- alone or networked.)

An automated circulation system providing an electronic card catalog and circulation record. A bulletin board for dissemination of information and management functions including report/ statistical preparation, MARC (Machine Accessible Reference Catalogue) catalog and inventory control.

A wide area network (WAN) to provide building/district access to IMC electronic resources including the electronic card catalog.

A 14 digit bar code label which follows the standards set forth by the New Jersey State Library, and which can be read by the circulation system must be attached to every item in the collection.

High speed dedicated phone lines to provide for on-line data retrieval including access to resources such as the Internet and Dialog databases, as well as electronic mail.

Provide for an electronic card catalog which offers gateway access to other catalogs in the region/state.

The multimedia development station(s) should incorporate computers, videocassette recorders, CD-ROM and videodisk players, scanners, cameras, and the appropriate software and peripherals for both production and playback. A production lab in the Instructional Media Center offers ready access to needed resources.

Consideration should be given to resource sharing. Therefore, computer terminals with laser disk players, CD-ROM players, and on-line access to reference information and holdings of other libraries, as well as, hookups to printers and other peripherals should be provided. Telnet, FTP and other protocols as developed should be made available for patrons' use.

Twenty four hour dial-in access to electronic resources should be provided to the entire school community to facilitate and encourage after school usage. Standardize modems to the maximum baud rate available within the budget. Wherever possible include ISDN and cable modem access.

In areas where security may be needed, the collection should be protected by sensing

devices to prevent unauthorized removal of materials from the center.

2. RESOURCE APPLICATIONS

Additional resources and services should include:

A fax machine (plain paper type) to expedite inter-library loans (both requests and receipt of materials and resource sharing).

A security system to guard against theft of materials.

The "head-end" of the school /district's video distribution system. This will provide for the dissemination of video based information (videocassette and television) throughout the facility.

A satellite dish (downlink) to receive broadcasts to facilitate interactive classroom and distance learning programs.

Secure, climate-controlled storage space for hardware and software.

Access to commercial and instructional TV over cable, and other communication highways that permit specific programs or video on demand to be piped on request into classrooms.

An electronic bulletin board that identifies resources and resource services and allows school-wide information exchange.

N. DISTANCE LEARNING

Distance learning is an integrated system that can include voice, video, and data capable of delivering quality curriculum and instruction to schools. It is an instructional delivery system which offers the potential to link students in more than one site simultaneously via two-way communication. The world is brought into the classroom by bringing together people, places, and ideas - regardless of geographic constraints.

Successful distance instruction requires new classroom management strategies and the ability to use technology. Teachers should project an intellectually and emotionally engaging "telepresence." Building virtual communities of learners is also vital.

There are several possible configurations for integrating distance learning into the curriculum. Some require more equipment than others, some more staffing. The decision on equipping the facility should be made at the design stage because its configuration should be based upon the teaching methodologies, not the other way around. Distance learning includes desktop and room videoconferencing, interactive television (ITV), and telecommunications-based activities.

Provision should be made for recording distance learning sessions.

Because distance learning may play a role in both the Computer Lab and the Computer Cluster, they are included in this section.

1. COMPUTER CLUSTERS

NOTE: Refer also to a prior section on "The Generic Classroom."

Clusters help to provide small group instruction and give students the freedom to explore. Clusters or mini-labs are best located within or adjacent to the standard classroom setting.

Computer clusters could be provided with an expandable computer monitor system that would enable students and teachers to see each other's work on their own monitors. This creates a collaborative, problem solving environment and also cuts down on unnecessary movement.

Clusters may be shared between classrooms or departments and should be networked. Their capacities will vary. Typical uses for these clusters include word processing, data base, spread sheet, computer-assisted instruction, simulations, access to data bases, visual telecommunications information transfer, sharing of information and videodisk capability. Each telecommunications cluster must be planned individually in accordance with curriculum needs.

The number of printers required to support a given number of computers is determined by the usage and speed of the printers and whether or not they are networked. Clusters or mini-labs devoted primarily to word processing require higher page per minute total output.

Subjects which may be appropriate for the computer cluster include the corrective reading, writing, and mathematical classroom; special educational classes; and the volunteer's room, if provided. The speech room, in addition to computers, may be equipped with microphones and speakers on the outside for parent use when observing the class.

Note: Planners should determine spatial needs for equipment in clusters or mini-labs before determining over-all area requirements. Whenever possible the computers should be arranged so that the instructors have visual access to check the progress of the students.

2. **THE COMPUTER LAB**

Labs serve multiple purposes, e.g. staff development, adult education, etc. For many districts, this is the first step in meeting technological needs and total integration.

The area known as the computer lab warrants more than usual flexibility and should be considered as a multi-purpose, multi-discipline teaching environment. Therefore, locating the computer lab adjacent to the instructional media center might be advisable.

The configuration of a computer lab should be multi-purpose and multidisciplined and its design determined by whether it is to be a teacher-directed activity area, a student-directed activity area, or a combination of the two. It is assumed that the teacher work station and the student work stations are networked. It should provide for the integration of laptops because in the future students may be provided with laptops for home/school use. Provisions should also be made for telecommunications-based activities and desktop videoconferencing.

Teacher-directed labs may be configured in a conventional classroom seating arrangement, but flexibility must be maintained. Student-directed labs may have computers lined along the perimeter walls of the room with work tables in the middle. A combination teacher-directed and student-directed lab may have "islands" of computers or "fingers" throughout the room. This type of configuration reduces internal lab traffic around computer work stations while allowing teacher access to students and screens.

Teachers must have visible access to all student work. Strive for sight lines or use technology that allows a teacher to observe all monitors from one place in the room.

Provide space in the computer lab for students doing paper work. Up to one half of the class can be expected to engage in some paper activity at any given time. Students can be expected to do short demonstrations at computer stations. This will often be combined with written work.

Provide a dedicated line for a telephone and modem or cable modem at the teacher's command center. Modems should support the highest baud rate or bandwidth. Consider multimedia access over a network for the computer lab.

The file server and associated printer should be wired to a dedicated circuit with an uninterruptable power supply. A rule of thumb is to provide a switched 20 amp dedicated circuit for every five computers. This is based on the amount of electrical power required by disk drives, monitors, and power supplies. Protect equipment from overloads and brown-outs. Consider using surge devices directly on the power receptacle. Decide in advance, wherever possible, on the number of computers required and the preferred direction of future expansion. Design conduits or wiring trays for future technologies.

One computer per student is desirable. Provide one ink jet printer for every five computers or fraction thereof as a rule of thumb. Fewer printers are needed if using higher speed printers. The actual number of printers required to support a given number of computers is determined by the usage and speed of the printers and whether or not they are networked. Labs devoted primarily to word processing require more printers or page per minute capabilities.

Provide space for the file server in an accessible but out of the way location in the lab. If the lab has multimedia access, provide countertop space near the file server for a CD ROM player and a videodisk player. Build organizational features specifically designed for easy access to materials and general storage. Provide adequate work space area around computer workstations to allow for student cooperative learning activities and books.

Ambient lighting must be controlled to avoid glare on monitor screens. Painting the walls a matte finish helps to reduce glare. Indirect lighting, obtainable through stem mounted up lights and parabolic diffusers, is desirable. Daylight must be controllable by means of shades, blinds or drapes.

Electronic equipment generates heat. Each station generates as much heat as an additional person in the room. Provide air conditioning with thermostatic control for year round use. Particular attention must be paid to the placement of heating units, fans, and ceiling diffusers. They must not be located over or by the computer because of the dust factor. Additional ventilation or air conditioning may be necessary for the file server.

Locate facilities in areas open to the public during non-school hours and provide access to rest room facilities. Locate away from vulnerable windows. Second floor locations are desirable.

Provide electronic access control, a surveillance system or door locks with deadbolts, where permitted, or metal flanges covering the latchbolt and strike. Any glass vision panels in doors to the lab should be security protected.

Provide static-free floor surfaces.

Provide a fixed or mobile computer station for the teacher. It should include a projection system, printer, paper tray, laser disk player, and video cassette recorder. Dedicated circuit outlets must be color coded or otherwise marked. Smart marker board projection systems can be used for teacher-student interaction to projected computer images.

Provide a (ceiling track mounted) pull-down screen or large-screen monitors, if possible. Because computer images projected on untreated walls lack clarity, use a 4x5 clear markerboard and absolutely smooth wall surface only as a last resort. There are markerboard wall coverings that can be used both for projection and writing.

Provide a lockable storage cabinet for manuals for all programs, software, printing paper including hanging files for printouts, blank disks, copies of various programs for student use, miscellaneous paper, and materials for cleaning computers and monitor screens.

Consider providing fireproof storage for backups and program disks. Fireproof storage in the administrative area may be enlarged to house these items.

Provide display area for computer related magazines and other relevant print material.

O. INTERACTIVE CLASSROOM

1. NEW CLASSROOM STRATEGIES

Students in several sites may be linked simultaneously via two-way communications in the interactive classroom. This demands an instructional methodology that is sufficiently different to warrant another paradigm. The classroom should offer greater opportunities for student interaction than traditional single-classroom settings.

All systems should provide compatibility ITU H.320 or other internationally accepted standards. Systems design on proprietary formats will be limited to communicating within that format. International standards have been established to define how video and audio information is compressed and transmitted. The H.320 (read H-dot-three-twenty) standard means video and audio signals may be exchanged between systems manufactured by different vendors. Videoconferencing systems that do not conform to H.320 standards will only support connection to systems developed by the same vendor.

The equipment installed in this classroom -- television cameras, large screen monitors, multi-media equipment, microphones and mixers, modulators and fax/scanner (w/OCR capabilities) machines -- require careful placement and protection from unauthorized use. The interactive classroom may be designed with computers for the exchange of video and data. All power considerations and protection as indicated in this document should be utilized in formulating any system for the interactive application.

2. DESIGN CONSIDERATIONS

Each site should be capable of being both the sending and receiving location and therefore should be equipped similarly. Consider the following factors:

Different camera techniques are possible. Remote controlled equipment is available. The teacher has the ability to control switching between cameras.

In the receiving schools the cameras are focused on the class and can be operated by the teacher in the sending classroom. The teacher on site at the receiving school should monitor the room and be available for troubleshooting, classroom control, faxing, and testing scenarios.

An option using a two-camera sending system employs an instructor camera that automatically follows the instructor anywhere in the room and can be manually controlled as well. The student camera automatically zooms to the student who is speaking.

Teachers may use video cassette recorders and/or videodisk players, or data interconnections such as a LAN or the Internet to transmit pictures and other data. The equipment configuration should reflect these needs and specify a switcher capable of handling multiple inputs. A multimedia computer should be powerful enough to accommodate diverse video input.

A document camera is recommended for transmitting demonstrations and images from books, notes, and papers.

A fax/scanner or shared screen data access provide a means for sharing assignments, homework, and examinations between sites. Provide a dedicated telephone or cable line for this purpose. Alternatively, the computer at the sending site can be used to transmit to printers at the receiving sites. Provide a dedicated line for telephone, modem, and fax/scanner.

The audio system must be sensitive enough to pick up all students' voices from their normal positions while filtering out excessive ambient noise. Providing the teacher with a wireless lavaliere microphone permits freedom of movement. This requires a transmitter, receiver, batteries, and Federal Communications Commission (FCC) frequency allocation. The teacher should be miked separately. Group the seating for students in ways best for microphones. Computer-controlled, hidden microphones provide for the most natural interaction.

A dedicated interactive classroom should be connected to the instructional media center via a LAN or similar network. In lieu of a network, locate the classroom near the instructional media center for easy access to audio-visual resources.

Locate away from normally noisy areas such as the cafeteria, gym, music, or shop rooms.

Provide appropriate paths for the floor camera. Clear camera shots must be obtained of the teacher, students, and displays. Make sure that sight lines in the receiving locations are appropriate for students to observe the teacher and the displays.

The classroom size and configuration must be appropriate for the number of students. It must also accommodate the mobility of the teacher and the camera.

Provide noise-free, grounded power circuits. An adequate amount of power is essential.

Control of the public address system, including any speakers, must be provided in the interactive classroom.

Daylight must be controlled; e.g., blinds, and drapes. Glare on screens must be avoided.

Uniform, ambient light is essential; stem lighting and upgraded fluorescent fixtures with parabolic egg crates and color corrected tubes are recommended. Staggered light fixtures are desirable. Cameras do not require special lighting, but they cannot shoot into light.

Walls should be a flat, light, neutral color and be illuminated evenly.

Block walls, windows, vinyl floors, and markerboards create a "live" room. Deaden walls with approved fire rated materials; e.g. carpeting or acoustic ceiling tiles, windows with drapes, floors with carpeting suitable for rolling a TV camera on its stand. Block sound vibration and diffuser noise from climate control equipment. Configuring and sizing of duct work must take acoustics into account.

Provide temperature and climate control for year-round use. Electronic equipment generates heat. HVAC equipment, including motors, air ducts and diffusers, must be designed with sound transmission levels acceptable for broadcasting from and to dedicated rooms. Sound baffles should be built into supply air ducts, and air velocities kept low to preclude diffuser noise.

P. TRANSPORTABLE SYSTEMS

Many of the design considerations of the dedicated interactive classroom also apply to transportable systems. Similar equipment is found in both configurations, although additional monitors, cameras and other peripherals are typically included in the dedicated classroom.

Transportable or roll-about systems are frequently stored in a wheeled cabinet or cart which removes the need for a dedicated interactive classroom. (Appendix E, Figure 7 and 8.) The portability of the unit allows most classrooms on a floor with appropriate connectivity to be used as a videoconferencing site. However, the unit cannot be easily transported between floors or up/down steps.

Another benefit of a multiple roll-about systems is the security that is provided with the cabinet design. When not in operation, the document camera, microphones, control panel or wireless keypad, and other peripherals may be stored securely within the locked cabinet.

While the required financial investment is typically less than that of a dedicated interactive classroom, the transportable system is designed to comfortably serve fewer students than can be accommodated in the dedicated classroom.

Usually one or two monitors are situated on top of the cabinet or cart. The integrated system frequently includes at least one camera mounted on a pan/tilt head, an audio system, and control system. A graphics or document camera is commonly used to share documents, charts, maps, objects, and other graphics.

A dual-monitor system can typically display a combination of live video, a captured still image, and/or a computer application on each monitor, while a single monitor system uses picture-in-picture to display more than one type of display.

Q. DESKTOP VIDEOCONFERENCING SYSTEM

Desktop videoconferencing refers to applications that can run on standard desktop computer systems such as an Intel-based PC, Macintosh, or Unix workstation. In addition to transmitting

video and audio, many desktop systems support sharing of computer files and applications between the sending and receiving sites.

Application sharing allows a student or teacher to initiate a software program at one site and then "share it" with remote users. Either side can take control of the software and make changes. Standard word processing software as well as Internet browsers are examples of software that can be shared. In addition, a number of desktop videoconferencing systems offer a whiteboard or notebook that can be shared. This kind of sharing encourages collaboration between the sending and remote sites.

A stand-alone computer may serve as a desktop videoconferencing system. However, the number of students that can be served simultaneously by a single computer is limited. A large screen monitor may be added to the configuration. However, the quality of the image will decline as the size of the image is magnified if adequate bandwidth is not provided.

Another option involves integrating a computer lab that incorporates a computer - video distribution system and a desktop videoconferencing system. Teachers and students may interact with each other via the keyboard and mouse. Each student may view remote classrooms, software applications or images projected by the document camera on his/her computer. The instructor may also view student monitors and share applications in both the originating and remote sites.(Appendix E, Figure 9 and 10.)

Various peripherals can be added to accommodate different needs and information sources. For example, the system may include a document camera, videocassette recorder for playing videotapes and recording the lesson, and large screen monitors to display what is being sent and received. A switcher capable of handling multiple inputs is needed.

The need for a fax machine is optional because desktop videoconferencing permits the sharing of assignments, homework, and examinations between sites. The same information can be printed at the receiving sites.

International standards have been established to define how video and audio information is compressed and transmitted. The H.320 (read H-dot-three-twenty) standard means video and audio signals may be exchanged between systems manufactured by different vendors. Desktop videoconferencing systems that do not conform to H.320 standards will only support connection to systems developed by the same vendor. Other standards are emerging for data sharing, video and audio transmission via POTS (plain old telephone system) lines and mobile communications.

R. SATELLITE

Satellite delivery of educational programming is useful and efficient on occasions when a single resource must be distributed to a wide area (e.g. statewide, regionally or nationally). This system can easily be made interactive (2-way audio, 1-way video) when used in conjunction with a telephone, keypad, and/or telecommunications services.

A satellite system can be used to provide low-enrollment or otherwise unavailable courses to students. Numerous producers of student and professional development currently provide regularly scheduled courses.

To receive satellite programming, a school must own or have access to a satellite receiving

system (dish) or to a system (cable, fiber optic, or ITFS) capable of relaying a satellite's signal from the dish site. The original program is transmitted up, or "uplinked," to a geostationary satellite which, in turn, processes the signal and retransmits, or "downlinks" it to potential receive sites in a wide area, typically the entire continent. When a school wishes to utilize a satellite-delivered program, typically it would arrange with the producing organization for authorization, since most such programs are covered by copyright.

Satellite downlink signals come in two varieties: Analog and Digitally Encoded.

An Analog signal can be used by any site having an adequate receiving system. The signal is identical to a regular TV broadcast signal, differing only in the frequency range used to transmit it to the receiver.

A Digitally Encoded signal contains a digital signal which represents the content of the analog signal, much in the manner of a compact disc recording. Like a compact disc, the digital signal has the capability of containing a much larger amount of material (programs) within a single channel. An Analog satellite channel can accommodate up to 2 programs simultaneously. A Digitally Encoded channel can, depending upon the encoding system used, accommodate 8, 16, or more programs simultaneously.

Because of the obvious advantages of the Digitally Encoded satellite signal over Analog, satellite transmission is quickly moving to digital as the standard. Many producers do still offer programs in the Analog format during this period of transition, but Analog is disappearing in a manner similar to that of 16-mm film, the vinyl audio recording, and the rotary dial. Schools considering the purchase of a satellite dish should, therefore, consider a system capable of receiving Digitally Encoded Video.

Satellites in the geostationary (staying in one place relative to the Earth's surface) domestic arc are located above the Earth's Equator. As the distance between the equator and the receive location increases, distance and atmospheric attenuation, or weakening, of the radio signal increases.

Since New Jersey is quite far north of the arc, the signal is weaker from the satellite than it would be in, for example, Georgia. Therefore, the 10-foot diameter mesh dish, which might be adequate in Georgia, might not work at all in New Jersey. The larger the diameter of the dish, the stronger the signal will be. In 1988, technical experiments were conducted by the Satellite Educational Resources Consortium (SERC), under a Star Schools grant, to determine the dish most suitable for use at this latitude. The conclusion was that, at a minimum, a 12-foot diameter, solid (as opposed to mesh) construction dish was required to receive signals from all of the satellites in the domestic arc. Although a 10-foot mesh dish is usually adequate for receiving the high-power entertainment satellite signals, it is inadequate for receiving the relatively low power signals from satellites relaying special-purpose signals, such as educational programming. When installing a steerable satellite dish in New Jersey, therefore, a dish reflector of solid construction and having a diameter of at least 12 feet is required.

A less expensive alternative to the steerable dish is a smaller, 4 to 6-foot fixed position dish. This is similar in appearance to the increasingly popular DSS dishes which are beginning to appear on homes to receive the services intended to be cable TV alternatives, but they must be larger to receive the weaker signals, and they are useful only for receiving Digitally Encoded video. The cost is approximately half that of a steerable system. The disadvantage to the Fixed Position dish is that it must be permanently aimed at only one satellite and cannot be easily

re-directed. A school subscribing to only one program service and which has no interest in exploring the opportunities presented on other satellites can install such a system to its advantage. The advantages of a Fixed Position dish are cost, size, and ease of mounting.

S. ITFS (INSTRUCTIONAL TELEVISION FIXED SERVICE)

ITFS is a point-to-multipoint transmission service licensed by the Federal

Communications Commission (FCC) for the purpose of transmitting instructional programming from a central location to receiving locations anywhere within its range. An entity such as a college, a school or district, or a regional instructional consortium involved in the production of educational television programming can use ITFS in its distribution.

It has a useful range from transmitter to receiver of approximately 20 miles, depending upon the height of both the transmitting and receiving antennas. The service has proven useful to school districts in the distribution of programming among their many schools. In addition, distance learning providers use ITFS to relay signals from a centrally located satellite dish to area schools, and colleges transmit regularly scheduled courses to off-campus sites.

There are currently several ITFS stations in operation around New Jersey. Coverage includes areas within approximately 20 miles of locations in Montclair, Union, Trenton, Warren, Mercerville and Camden. Others are planned.

T. TV PRODUCTION FACILITY

1. LEVEL OF FACILITY NEED

A Closed Circuit Television (CCTV) studio complex provides equipment, staff, and resources to produce closed-circuit television programs for distribution and distance learning.

Facilities should be designed to a particular level of skill development in students and will, therefore, vary in size. A high school offering courses dedicated to TV production may require a control room and editing and post-production space in addition to a TV studio. The total area ranges between 1,000 and 13,000 square feet. A middle school facility can be the size of a generous classroom. The elementary school studio can be even simpler and requires much less space, which can be shared.

The development of the hand-held, high sensitivity camcorder has reduced the need for many costly accessories. The video cassette and microphone are built-in; playback through the camera, a hook-up to a TV receiver, simple assemble-editing, and re-recording onto another machine are all possible.

Acoustical and lighting design must be coordinated and in place prior to the installation of production equipment. Note that the demand for lighting may require an increase in the electrical supply and area dimmer control.

When planning a TV production facility, consider the following items:

Determine the proper fit of the electronic technology to the instructional programs.

Determine the level of student and staff use to establish the need for appropriate

equipment.

The preferred location of a TV production facility is adjacent to the Instructional Media Center. Thus (audio) taping facilities and the "head-end" can be shared. Locate away from noisy areas.

Provide a workable arrangement of equipment that includes easy access and operation for student and staff. Provide an area suitable for staging any activity that shall be produced.

The set area should be sufficiently flexible to accommodate a variety of individual props and materials for desired settings.

Provide a closed-circuit network to classrooms, gym, auditorium, cafeteria, the Instructional Media Center and conference rooms.

TV equipment should be attached to heavy-duty cable. RG-6 is the minimum recommended. Run cable in the ceiling or in molding below the ceiling and on walls. Provide cable covers for floor-run cables. Cable drops at each end of the classroom are desirable.

2. REQUIRED BUILDING COMPONENTS - ELECTRICAL POWER AND ELECTRONICS

LIGHTING: Exclusion of daylight and control of artificial light is a major requirement. Determine if ceiling mounted lighting bars and/or tripod mounting lighting kits are preferred. The lighting demand of a large TV production facility may require an increase in the electric supply.

CLIMATE CONTROL: Provide climate control for year-round use. Lights and technology equipment generate heat and must be factored into the system design. HVAC equipment, including motors, air ducts and diffusers, must be designed with sound transmission levels acceptable for broadcasting from the studio. Sound baffles should be built into supply air ducts and air velocities controlled.

ACOUSTICS: Ceilings and walls must incorporate sound-deadening materials that serve to absorb noise from adjacent areas, isolate reflected sounds off nearby structures or which reverberate within the room. A cyclorama track and curtain may be desirable.

SECURITY: Provide electronic access control, a surveillance system, or door locks with deadbolts, where permitted, or metal flanges covering the latchbolt and strike. Glass vision panels in doors to the lab should be security protected.

ELECTRICITY: Provide noise-free, grounded, and properly phased power circuits. An adequate supply of power is essential. Television and monitor screens may flicker if the power is inadequate.

SUMMARY

This document is a resource guide for school boards, administrators, staff and design professionals. It contains standards recommended by Educational Facility Planning Services and the Office of Technology to implement what we know today and to be creative in the design for tomorrow.

Educational technology is a powerful tool that enhances interactive teaching and learning.

It is the concept of technology as a tool for learning that should emerge from this document, not the individual mechanisms. Continuous access to existing information and access to information as it emerges is of extreme importance for the present and future teachers and learners.

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[1] Educational Media Association of New Jersey Philosophy Statement, October 1995, page 9.03.

[2] Ibid.

New Jersey Department of Education

Take Me To . . .

Facility Standards for Technology in New Jersey Schools

APPENDIX A: EDUCATIONAL SPECIFICATIONS FORM EXAMPLE

I. GENERAL INFORMATION

COUNTY_____

SCHOOL DISTRICT_____

SCHOOL_____

TYPE OF SPACE_____

FORMER USE OF SPACE (CHANGE OF USE OR SUB-STANDARD UPGRADE ONLY)

_____

_____

NEW CONSTRUCTION_____ ADDITION_____

REMODELING _____

II. PHYSICAL SPECIFICS

A. NUMBER OF STUDENTS_____

B. NUMBER OF INSTRUCTORS_____

C. NUMBER OF SIMILAR SPACES_____

D. SPATIAL RELATIONSHIP

III. DESCRIPTION OF INSTRUCTIONAL ACTIVITIES

IV. SPECIAL FEATURES

APPENDIX B: GLOSSARY OF TERMS

10BaseF - The Fiber Optic implementation of Ethernet. It has been certified as a standard by the Institute of Electronic and Electrical Engineers and is defined in the 802.3 standard. It transmits at 10 Mbps.

10BaseT - The Unshielded Twisted Pair (UTP) implementation of Ethernet. It has been certified as a standard by the Institute of Electronic and Electrical Engineers and is defined in the 802.3 standard. It transmits at 10 Mbps.

100BaseF - The Fiber Optic implementation of Ethernet. It has been certified as a standard by the Institute of Electronic and Electrical Engineers and is defined in the 802.3 and 802.12 standards. It transmits at 100 Mbps.

100BaseT - The Unshielded Twisted Pair (UTP) implementation of Ethernet. It has been certified as a standard by the Institute of Electronic and Electrical Engineers and is defined in the 802.3 and 802.12 standards. It transmits at 100 Mbps.

ANSI - American National Standards Institute.

ATM (Asynchronous Transfer Mode) - ATM switching protocol can handle all types of traffic; voice, video, data, and image, from 25 Mbps to 622 Mbps and up into the gigabit range. The details of these transmission techniques have been defined by the ATM forum.

Backbone - A facility (e.g. pathway, cable or conductors) between telecommunication closets, or floor distribution terminals, the entrance facilities, and the equipment rooms within or between buildings.

Baud - Unit of data transmission speed equivalent to approximate number of bits per second.

BBS (Bulletin Board Services) - Computers which contain information, training, software, and files which one can view and, often, download for usage.

BOCA - Building Officials Code Administration.

Bridge - A Local Area Network device connecting similar Local Area Networks.

CC (Communications Closet) - The CC acts as the distribution point for communications cable from the Communications Equipment Room to either the end user or to communications outlets in user areas. The CCs are centrally located near user areas and are connected to user areas via UPT cable runs of no more than 290 feet.

CCTV - Closed-Circuit Television.

CD-I (Compact Disk Interactive) - CD-I stores text, audio, video images and animation. CD-I requires a CD-I player and will not work on a regular CD-ROM player.

CD-ROM (Compact Disk-Read Only Memory) - A very high-density information storage medium that uses light to read digital or audio information, such as a compact disk player found in home entertainment systems.

CER (Communications Equipment Room) - The CER is the entry point for communications into the building. It houses the head-end equipment of the school's communications system and is connected via cabling to Communications Closets for horizontal distribution to the end user. The CER also functions as the demarcation point, for external systems such as telephone company lines, cable television system connections using fiber optic cables, and contains other termination hardware for these systems. Can serve as a CC within the 290 feet limit.

CO (Communications Outlet) - The CO is the location of the connection point between the horizontal cable and the terminal devices such as work stations in the user areas.

Coaxial Cable - Transmission medium consisting of one central wire conductor (two for twin axial cable) surrounded by a dielectric insulator and encased in either a wire mesh or an extruded metal sheathing. Coaxial cable comes in many varieties, depending on the degree of EMI sheathing afforded and voltages and frequencies accommodated; also called "coax."

Codec (short for coder-decoder) - A codec is a device that compresses and decompresses video, audio and data. Codecs are an integral part of any videoconferencing system that uses compression technology. The codec also acts as an interface device between all the equipment and the network. Video, data, and audio all connect into the codec which transmits a single, digital signal over the network to the remote location(s).

EIA/TIA (Electronic Industries Association/Telecommunications Industry Association) - This association sets standards for telecommunications infrastructure.

E-mail (Electronic-mail) - Electronic mail is used to send letters to other people, much like postal mail, but e-mail is sent through a computer network to a person's computer.

EMI (Electromagnetic Interference) - A device's radiation leakage that couples onto a transmission medium resulting from the use of high-frequency wave energy and signal modulation. The EMI is reduced by shielding. Minimum acceptable levels are detailed by the FCC and /or manufacturer specification.

Ethernet - A standard set by the Institute of Electronic and Electrical Engineers (IEEE) and is defined in the 802.3 standard. Thin Ethernet is many times referred to as Ethernet which is RG58 Coaxial implementation of Ethernet. It transmits at 10 Mbps and can connect up to 1024 nodes in total. Fiber optic connections between repeaters should not exceed 425 feet maximum.

FCC (Federal Communications Commission) - An independent government agency established by the Communications Act of 1934 to regulate the broadcasting industry. The Commission later assumed authority over cable. The FCC is administered by seven commissioners and reports to Congress. The FCC assigns broadcasting frequencies, licenses stations, and oversees interstate communications.

FDDI (Fiber Distributed Data Interface) - The first networking standard developed specifically for fiber optic media. It is specified by the ANSI (X3T12). It serves as a backbone network for lower-seed LANs or

as a stand-alone high-speed LAN.

Fiber Optics - A general term describing the transmission of data by the use of a modulated light-wave signal, transmitted over glass or plastic medium, and received by a light-sensitive receiver.

Frame Relay - A high speed packet switching protocol used in Wide Area Networks (WAN). Provides granular service up to rates of 1.544 Mbps and is suited for data , image and voice transfer.

Hub - Electronic equipment typically located in the CER/CC for interfacing nodes.

HVAC - Heating, Ventilation, and Air-Conditioning.

IEEE (Institute of Electrical and Electronic Engineers) - An international society of professional engineers that issues widely used networking standards.

IDLS (Interactive Distance Learning Service) - IDLS provides two-way, full motion audio and video and allows the interconnection of multiple locations. This service is currently comprised of one transmit and three receive paths which allow sites to interact, via scheduled sessions, with other IDLS sites either within a county or LATA. This service is currently offered by Bell Atlantic.

IMC (Instructional Media Center) - The IMC is basically the resource hub for the school and collocated with the CER. In the IMC, access to a wide variety of instructional materials is provided, as well as staff training and seminars.

ISDN (Integrated Services Digital Network) - ISDN is a set of standardized customer interfaces and signaling protocols for delivering digital circuit-switched voice/data, and packet-switched data services. ISDN is designed to provide a standard interface to custom premises equipment such as computers, telephones, facsimile machines, and routers.

ITFS (Instructional Television Fixed Service) - ITFS is a point-to-multipoint transmission service that provides instructional programming from a central location to receivers located within a radius of approximately 20 miles. An entity such as a college or regional consortium involved in the production of educational television programming can use ITFS in its distribution.

Internet - A commercial WAN providing various services, such as electronic mail, database access, informational services, etc.

LAN (Local Area Network) - A type of high speed data-communications arrangement where all segments of the transmission medium (coaxial cable, twisted-pair, or fiber optic cable) are in an office, lab or campus environment under the control of the network operator and provides a high-bandwidth, low-cost medium to which many nodes/users can be connected.

Modem (Modulator/DeModulator) - Device that connects terminals and hosts through analog links by converting data signals to analog signals and back again.

MPC (Multimedia Personal Computer) - Computer which utilizes multimedia, where materials are presented using multiple forms of presentation data.

MPEG (Moving Pictures Experts Group) - MPEG are standards recommended by the International Standards Organization (ISO) governing digital audio and video compression for CD-ROMs and broadcast

video.

NFPA - National Fire Protection Association.

Nodes - A point of interconnection to a network, such as computers, printers, routers, faxes, bridges.

OCR (Optical Character Recognition) - Documents that are designed to support OCR may be scanned resulting in the creation of electronic images of the documents and indexing of textual information. This process permits searching of indexed information.

OSHA - Occupational Safety and Health Administration.

PBX (Private Branch Exchange) - A private telephone exchange that serves a particular organization and has connections to the public telephone network; refers to a multi-line telephone exchange terminal with various features for voice and data communications.

PEOSHA - Public Employees Occupational Safety and Health Administration

Plenum - A space behind a finished surface used for environmental air flow.

1. Remote Access - The ability to access a network from a location not directly connected to the network site.

RG-6 - Coaxial cable.

RJ-11 - Standard modular interface for voice communication.

RJ45 - Standard modular interface for voice and data communications.

Ring Topology - A network topology in which each node is connected to two adjacent nodes.

Router - A device to connect similar and dissimilar LANs and also WANs.

SNMP - Simple Network Management Protocol widely used to control and configure devices on a LAN and on a WAN.

Star Topology - A network topology consisting of one central node or hub with point-to-point links to several other nodes. Control of the network is usually located in the central node or switch, with all routing of network message traffic performed by the central node.

Surge Protection - A device that protects any electronic component connected through it to the building power system. Protects against over voltages (spikes and power surges).

Switch Technology - A device that creates temporary point-to-point connection between two communicating nodes.

TCP/IP - Transmission Control Protocol/Internet Protocol. Also known as the Internet Protocol Suite. This suite of protocols is used on the Internet and is widely used for heterogeneous internet working.

Token Ring - A type of local area network based upon the IEEE 802.5 standard, where a token must be

received by the attached terminal or workstation before that terminal or workstation can start transmitting.

Topology - The physical and logical relationship of nodes in a network typically having a star, ring or bus configuration. Network topology can be centralized in a Star with a concentration point for all nodes or distributed as in a Ring with point-to-point connections.

Twisted Pair - This type of wire consists of two insulated copper conductors that are wound around each other to reduce the effects of electrical noise. The two available types are Unshielded Twisted Pair (UTP), used by most systems, and Shielded Twisted Pair (STP), used by some systems.

T1 - A term for digital carrier facility used to transmit a DS1-formatted digital signal at 1.544 Mbps. A T1 frame has 24 timeslots or channels.

UL - Underwriters Laboratory.

UPS - Uninteruptable Power Supply. This device allows for orderly shutdown of equipment in event of power failure or low voltage conditions.

WAN (Wide Area Network) - A WAN connects computers and peripherals over long distances, different than a Local Area Network. A WAN may network computers from building to building.

Wireless - Alternate method of connecting nodes using optical and radio technology on both LANs and WANs.

World Wide Web (WWW) - The World Wide Web is an Internet browsing system that allows for point and click navigation of the Internet. Web documents use hypertext, which incorporates text and graphical links to other documents and files on the Internet. Users may traverse the Web from any starting point.

APPENDIX C: ELECTRONIC COMMUNICATIONS SYSTEMS

INTRODUCTION

The intent of this appendix is to assist those engaged in planning and modernizing learning environments (board members, need assessment personnel, facilities planners, as well as financial officers) by clarifying terminology associated with current and emerging telecommunications and educational technology for instructional and support services.

Voice communications systems have always been prevalent within the schools. They have traditionally consisted of telephone systems and public address systems and their primary use has been administrative. Recent developments have led to the introduction of voice communications into the classroom as an enhanced learning tool.

Advancements in telephone technology have made it impossible to approach voice communications as a separate technology. Traditional twisted pair wiring is now capable of carrying video and data transmission as well as voice lines, full motion real time. Therefore, when planning or upgrading present facilities, the potential integration of both voice and data over the same pair of wires must be considered.

Voice communications can be an effective aid to learning and provide different functional uses to the

classroom. A brief description of some of the systems found in schools are as follows.

I. VOICE SYSTEMS

A. TELEPHONE

Telephone systems are primarily used to provide station-to-station voice communication either within or outside a school. Traditionally used strictly in an administrative capacity, telephones have been introduced into the teaching environment for teleconferencing as a link to home-bound students and to allow for discussions in distance learning situations. A telephone system can provide state of the art features such as voice and data capability and the ability to transfer calls to a teacher at home to provide for out-of-hours assistance. Telephones can also be used for remote control or access to school management devices or services such as electronically controlled energy systems or computer systems.

B. PUBLIC ADDRESS

Public address or intercom systems are used to send voice messages to individual classrooms or multiple rooms simultaneously. Its primary use is one way paging but some systems allow for two-way voice messaging. The public address system should be integrated into the telephone system and accessed via a telephone handset or microphone. Fixed speakers should be strategically situated inside and outside school buildings so that messages are intelligible in all areas of school property. Uses include general broadcast messages for all to hear, locating someone within a large area, or sending a message into a particular classroom.

C. TWO-WAY RADIO

A radio transmitter or "walkie-talkie" provides wireless communication from a central location to hand held units or from unit to unit over radio waves. As a supplement to the telephone system, it can send one way messages from a central location or from individual transmitters over short distances. Primarily an administrative tool, it can be used to send emergency messages to and from school buses, cars and vans. Other uses are for contact with security personnel or mobile personnel such as maintenance people.

D. AUTOMATED VOICE MESSAGING

Automated voice messaging or voice mail provides electronic telephone answering and message-taking and retrieval without human intervention. This technology is being used in schools to provide services such as the "homework hotline" for parents and teachers to check on assignments, or as a bulletin board for general information, such as late opening announcements, cafeteria menus, and sports events. Individual mailboxes for message storage and retrieval can be used by students, faculty, parents, and administrative people for out of hours messaging, or for people that are hard to contact during a normal business day.

II. INTEGRATED VIDEO/AUDIO SYSTEMS

Systems that use a video image in conjunction with an association audio signal can be referred to as integrated video/audio systems. These include television and other combined signals. The possible uses of a modern video/audio system are many. In order to allow for a variety of uses, the system must be flexible, configurable and reliable.

A. INTERACTIVE TELEVISION (TWO-WAY)

Two way interactive television systems allow two or more individuals/groups to exchange ideas or attend meetings/classes without the need to be in the same physical location as the other attendees. This type of video/audio system will usually require connection to other facilities through the use of a video transmission services provider. Service may be available through the local telephone company, the local cable TV provider, or other telecommunications service providers.

B. PRERECORDED TELEVISION

Prerecorded television includes video tapes, video disk, or other prerecorded media. Prerecorded programming can be made available from the individual activity area or from a central location, or a combination of both techniques can be used.

C. BROADCAST DISTRIBUTION

Broadcast distribution is one-way transmission of programming from a single point to one or more points. It can be used for distribution of live events, externally generated programming, or central distribution of prerecorded materials. This allows for larger groups to view the same material simultaneously and concentrated use of video/audio playback equipment. Externally generated programming may arrive via a roof top antenna, cable TV, satellite, or microwave link. These include programming from public broadcasting stations, Satellite Education Resources Consortium (SERC), Mind Extension University, and other providers of educational programming.

D. TV/DATA INTERACTIVE

TV/data interactive systems use an input device, (telephone keypad, computer keyboard, etc.) to obtain answers to questions, which when evaluated, determines which program material to display and/or which queries to present to the viewer. This is an area where many new applications are currently being developed. These will likely include the ability to retrieve segments of video/audio programming from an indexed database organized by desired subject. Databases of this type will likely include all types of information including current events in a real time or near real time fashion. Access to these systems will require integrated interconnections to telecommunications services providers such as the local cable television provider, local telephone service provider, or other service provider.

III. DATA SYSTEMS

Data systems generally fall into two categories within a school, instructional systems and non-instructional or support systems. Historically, wide spread use of the non- instructional systems preceded the instructional uses. Until the late 1970's only mainframe computer systems and their related terminals were capable of providing computer aided instruction (CAI) for the classroom. The number of terminals needed and the associated costs of highly trained operators and programmers made this option unfeasible for all but the most wealthy districts. With the advent of the microprocessor, things changed rapidly.

Computers and, more recently, computer networks are emerging as important tools in the learning process. Recognizing the importance of these tools, it is recommended that the following be available as tools to each classroom, student, and teacher.

A. COMPUTER SYSTEMS

Regardless of the platform (Apple, IBM, etc.), classroom systems should be high speed, color display networks where possible to provide access to information sources outside the classroom. Where networks are not possible or feasible, stand alone machines with modems are desirable.

B. ELECTRONIC MAIL

Electronic mail or E-mail is a means of removing two of the greatest barriers to communication, namely time and distance. Electronic mail is similar to voice mail in that a message is recorded and stored electronically. E-mail can be sent over phone lines to the bulletin board system (BBS) or to local area networks (LAN) via communication servers. E-mail may serve to pose questions on open forums in commercial services such as CompuServe, America On-line, or Prodigy. This can be accomplished by utilizing free access public support systems or one of the many noncommercial electronic bulletin board systems, such as New Jersey Link. Questions can be left and answers posted regardless of barriers of time and distance.

C. INFORMATION HIGHWAY

Access to the growing information highway is essential. This is usually accomplished through the use of a computer, modem, communication software, and telephone lines. In addition to the above-mentioned E-mail potential, on line searches can be conducted to obtain information from every corner of the world.

Access to worldwide communications can be gained through the Internet. Internet is a global linking of over 5,000 local area networks. Access to computerized library catalogues is available through both a dial-in telephone line setting and network connections.

D. ELECTRONIC BULLETIN BOARD SYSTEMS (BBS)

Electronic bulletin board systems (BBS) combine computers, telephone lines, and modems to provide access to the classroom from the outside and conversely provide a means for the classroom to reach out to outside information sources. BBS can be single line systems that provide one-to-one communication or multiline systems that provide one to many connections.

On a dial-out basis these systems can be used to access large databases of electronically stored information anywhere in the world. The access can be through commercial (pay as you go) services such as CompuServe, Prodigy, Dialogue or America On-line or through no-cost private or publicly maintained bulletin board systems. Sources for these telephone numbers can be found in many book stores or computer stores.

In dial-in situations, BBS can permit students at home to have access to information stored at their school regardless of the hour or day of the year. Electronic library card catalogues can be accessed through phone lines. Individual student papers or documents being prepared by a group can be stored on the BBS system and accessed by those involved when time permits.

E. FACSIMILE

Facsimile machines (FAX) can be used to transmit documents or images over long distances via normal telephone lines. The document image is encoded and transmitted over the telephone

lines. This technology can be used to share documents or images almost instantly between classrooms that are as close as the same building or as far away as continents. Fax technology can be stand alone, built into computers for modem or BBS transmission, and can be available as a shared resource in local area networks.

IV. ELECTRONIC NETWORKS

A. LOCAL AREA NETWORKS

Local area networks consist of multiple computer units tied together by high speed connections. While bulletin board systems serve to cover large areas at relatively low speeds, local area networks (LANs) connects limited areas, usually one room or building wing, at very high speeds. There are multiple topologies that can be used such as Token Ring (IEEE 802.5) or Ethernet (IEEE 802.3) that operate in the 10 to 16 megabytes per second range. They can provide shared access to limited resources such as pooled modems or high speed printers or provide shared access to software, data files, or graphical images.

B. WIDE AREA NETWORKS:

Wide area networks (WANs), sometimes called metropolitan area networks (MANs), are a hybrid technology used to interconnect networks or allow network connections between points normally beyond the generally accepted network distance limitations. This is usually accomplished over dedicated high speed communication lines via network modems, using line of sight or similar broadcast technology or over specialized media such as fiber optic lines. Wide area network concepts are sometimes used to segment local area networks to decrease network traffic in high use applications.

APPENDIX D: FLORIDA DISTANCE LEARNING NETWORK'S TECHNICAL GUIDELINES

Audio Conferencing:

Equipment: Two categories of equipment need to be addressed:

1) conference devices that are used on a table top and are composed of a speaker and a microphone;

A) Terminal devices are needed at each end of the call. Those terminal devices fall into two categories:

1) half-duplex; less expensive; and
2) full-duplex; more expensive.

B) Desirable features of conference devices (hand-sets):

1) mute button;
2) flash key to transfer calls;
3) battery support - optional.

2) and conference bridges that link multiple conference calls. This is usually a service provided at a charge by the telecommunications provider. Audio bridges are expensive and must have technical support.

Bandwidth: Telephony service.

Telefacsimile:

Equipment: Plain paper, group 3 fax machine with broadcast capabilities.

Standard: Group 3.

Bandwidth: Telephony service.

Video Tape Distribution:

Equipment: Method #1:

Tape produced from RF video feed of regular TV Broadcast (service) or Video server and distributed via mail or other means, etc. The following equipment is needed:
1) cabling to signal;
2) VCR or equivalent taping equipment; and
3) television monitor for viewing.

Method #2

Tape produced by copying downlinked information and distributed by mail, etc. The following equipment is needed:
1) steerable/fixed receiving dish;
2) cabling to signal;
3) VCR or equivalent taping equipment; and
4) television monitor for viewing.

Standards: Televisions: NTSC standards for television systems are contained in the FCC rules and Regulations, Part 73, Volume 3 are as follows:

Channel bandwidth	6Mhz;
Video bandwidth	4.2 Mhz;
Audio bandwidth	±25 kHz;
Picture Carrier	1.25Mhz above lower boundary; and
Modulation	AM composite picture and synchronizing signal on visual carrier together w/FM audio signal on audio carrier;
Scanning lines	525 per frame, interlaced 2:1,60 fields, 30 frames/sec;
Horizontal Frequency	15,734 Hz; and
Vertical Frequency	59.94 Hz.

Signal to noise ratio for video transmission:

TASO Picture Ratings (4 Mhz bandwidth);

- Excellent (no perceptible noise), 45 dB;
- Fine (noise just perceptible), 35 dB;
- Passable (noise objectionable), 29 dB; and
- Marginal (noise objectionable), 25 dB.

Video Cassette Recorder Standards:

- First Generation record/playback, broadcast quality capable w/Time Base Correction;

Tape Format	3/4" U-Matic, 1/2" S-VHS, 1/2" VHS, Betacam SP;
Input signal	NTSC composite, 1 volt peak to peak;
S/N	45 dB(color);
Horizontal Resolution	260 lines; and
Audio Frequency Response 50 Hz to 15 kHz.	

Other standards to consider:
FCC standards for RF devices and UL standards for safety on equipment and components.

Bandwidth: TV Broadcast video/audio feed at 6MHz analog uncompressed, or 90 Mbps digital uncompressed, or 1-3 Mbps digital compressed signal.

Dial-up low speed data transmitting and receiving (below 28.8 baud rate with text/file/image transfer; e.g. electronic-mail and Internet). Included with this application is stand alone workstations, with online public access catalog and/or other local library information systems resident on fixed disk or CD-ROM, with acces to the Internet.

Equipment:

1) computer;
2) modem which supports baud rates of at least 14.4 Kbps; and
3) Internet service provider who supplies electronic mail services.

Standards:

The following standards relate to computers and software:
Minimum hardware configuration-

PC:	MAC:
75 Mhz Pentium;	80 Mhz Power PC;
16 MB RAM;	16 MB RAM;
500 MB hard drive;	500 MB hard drive;
Quad speed CD-ROM drive;	Quad speed CD-ROM drive;
3.5" HD (1.4 MB) floppy drive; and 3.5" HD (1.4MB) floppy drive; and Super VGA monitor with sound & video capabilities.	Multiple scan Macintosh monitor with sound and video capabilities.

GUI:
- Current version of MS Windows or Macintosh operating system; and
- Web browser: HTML, 2.0 or better.

Networking:.
- Category 5 wiring;
- Fiber Optic Cable;
- TCP/IP; and
- Dial-in: Slip/PPP.

Network management: SNMP support

E-Mail:
- MIME compliant;
- SMTP gateway; and
- X.400 gateway.

Security:
- Network authentication: DCE/Kerberos 5.0;
- Link security: SSL (Secure Netscape); and
- Network security: Network firewall.

Multi-media reader: PDF format (Adobe Acrobat).

Library access: Z39.50, USMARC Bibliographic Records.

Relational data base access: SQL and ODBC compliant.

Directory access: X.500 compliant.

Modem standards should support v.34 interface.

Internet service provider should support the following:

- helpdesk for service and connection problems; and
- technical and training support to al eligible facilities.

Bandwidth: Telephony service.

Dial-up high speed (digital) data transmitting and receiving (equal or above 28.8 baud rate with text/file/image transfer; e.g. Internet multimedia applicatons, e-mail services.):

Equipment:

1) computer;
2) modem which supports baud rates at or above 28.8; and
3) Internet service provider who supplies electronic mail services.

Standards:

The following standards relate to computers and software:
Minimum hardware configuration-

PC:	MAC:
75 Mhz Pentium;	80 Mhz PowerPC;
16 MB RAM;	16 MB RAM;
500 MB hard drive;	500 MB hard drive;
Quad speed CD-ROM drive;	Quad speed CD-ROM drive;
3.5" HD (1.4 MB) floppy drive; and Super VGA monitor with sound & video capabilities.	3.5" HD (1.4 MB) floppy drive; Multiple scan Macintosh monit sound & video capabilities.

GUI:

- Current version of MS Windows or Macintosh operating system; and
- Web browser: HTML, 2.0 or better.

Networking:

- Category 5 wiring;
- Fiber Optic Cable;
- TCP/IP; and
- Dial-in: Slip/PPP.

Network management: SNMP support.

E-mail:

- MIME compliant;
- SMTP gateway; and
- X.400 gateway.

Security:

- Network authentication: DCE/Kerberos 5.0;
- Link security: SSL (Secure Netscape); and
- Network security; Network firewall.

Multi-media reader: PDF format (Adobe Acrobat).

Library access Z39.50, USMARC Bibliographic Records.

Relational data base access: SQL and ODBC compliant.

Directory access: X.500 compliant.

Modem standards shold support v.34 interface.

Internet service provider should support the following:
helpdesk for service connection problems; and
technical and training support to all eligible facilities.

Bandwidth: 56 Kbps service.

PC to PC/Mac to Mac Software and Screen Sharing (external point to point connection):

Equipment:
1) computer;
2) interface;
3) microphone & camera; and
4) software for videoconferencing.

Standards:
Computer standards are the same as stated above.

Interface standards for peripherals to be used in desktop software and screen sharing must adhere to the 56 Kbps connection (or ISDN connections as provided by channelization of a DS1-PRI if used). In the event ISDN interface is desired, an additional piece of equipment, NT1, is needed to complete the connection.

Software, microphone, and camera standards are different for each of the vendors selling such equipment and software. The standards of H.320 for video with 12 to 15 frames/sec. and T.120 for software/applications are needed.

(Note: Types of computers need not be the same on both ends of the connection. However, the communication software [T-120 standards] and the applications being used must be the same.)

Bandwidth:
Either (2) 56 Kbps or (2) channelized DS0 from DS1 as a minimum bandwidth.

PC to PC/Mac to Mac Desktop Video Conferencing:

Equipment:
1) computer;

2) interface;
3) microphone & camera; and
4) software for videoconferencing.

Standards:

Computer standards are the same as stated above.

Interface standards for peripherals to be used in desktop software and screen sharing must adhere to the 56 Kbps connection (or ISDN connections as provided by channelization of a DS1-PRI if used). In the event ISDN interface is desired, an additional piece of equipment, NTI, is needed to complete the connection.

Software, microphone, and camera standards are different for each of the vendors selling such equipment and software. The standards of H.320 for video and T.120 for software/applications are important. Cameras should be able to pan, tilt and zoom.

(**Note**: Computers need not be the same on both ends of the connection. Video conferencing communication software to accommodate H.320 and T.120 standards is needed on both ends of the connection. Application software to share between computers must be the same.)

Bandwidth:

Either (2) Kbps or (2) channelized DS0 from DS1 as a minimum bandwidth.

Group Video Conferencing:

Equipment:

1) codec (Coder/Decoder) on each end of the connection;
2) dual or single monitor;
3) pane control setup at each end of the connection;
4) white boards (opt);
5) auxiliary camera(s) (Opt.); and
6) room dedicated to equipment.

For multipoint connection the following are necessary:
1) MCUs to connect multiple sites;
2) scheduling procedures for multiple sites; and
3) dedicated room conferencing locations (e.g. environmental control of noise, lighting, and acoustics).

(**Note**: At this time connecting two different brands of video conferencing units, both using H.30 standards, may produce connection problems. Operators of the equipment would have to be familiar with both units being used.)

Standards:

Codecs must comply with ITU standards, H.320. 24-30 frames/sec.

Bandwidth:

384 Kbps is the minimum bandwidth.

Broadcast Video (one-way video) transmitting & receiving:

Equipment:

To produce one-way broadcast uplinked to satellite and/or distribution by microwave, cablecast, or other means, the following are needed:

1) extensive production rooms, equipment, and staff for program production and uplinking; and

2) uplink capabilities, microwave capabilities, or cablecast capabilities with remodulation of signal are needed for distribution.

To receive a one-way broadcast transmission, a satellite dish and receiver are needed.

- ITFS wireless cable system which includes one-way video and two-way audio.

Standards:

FCC license, NTSC standards.

Bandwidth:

6 MHz analog uncompressed, or 90 Mbps digital uncompressed, or 1-3 Mbps digital compressed signal.

Broadcast Video (interactive):

Equipment:

To produce one-way broadcast uplinked to satellite and/or distribution by microwave, cablecast, or other means, the following are needed:

extensive production rooms, equipment, and staff for program production and uplinking; and

1) uplink capabilities with distribution using microwave or cablecast for remodulation of signal.

Standards:

FCC license, NTSC standards.

Bandwidth:

6 MHZ analog uncompressed, or 90 Mbps digital uncompressed, or 1-3 Mbps digital compressed signal.

Telemedicine Video Conferencing:

Equipment:

1) codec (Coder/Decoder) on each end of the connection (full motion);

2) a mobile cart designed to house the equipment that can be adequately cleaned;

3) auxiliary camera(s) w/tripod;

4) document camera;

5) lapel mic(s);

6) VCR (for record and playback);

7) PC;

8) PC Video Scan Converter;
9) software package; and
10) dual monitors.
*Option - Slide to Video Transfer unit

Medical Equipment:

The system will be configured with medical instruments that have been adapted for use in telemedicine:
1) digital stethoscope package (send site);
2) digital stethoscope package (receive site);
3) Vascular/Doppler probe;
4) ENT Videoscope package;
5) QRS card EOG system; and
6) Pulsemetric Blood Pressure Card.

For multipoint connection the following is necessary:
- Scheduling procedures for multiple sites; and a room with a control of environmental noise, lighting and acoustics.

(**Note**: At this time connecting two different brands of video conferencing units, both using H.320 standards, may produce connection problems. Operators of the equipment would have to be familiar with both units being used.)

Standards:

Codecs must comply with ITU standards, H.320 30 frames/sec (for full motion video).

Bandwidth:

384 Kbps is the minimum bandwidth.

APPENDIX E: WIRING SYSTEM AND CLASSROOM DIAGRAMS

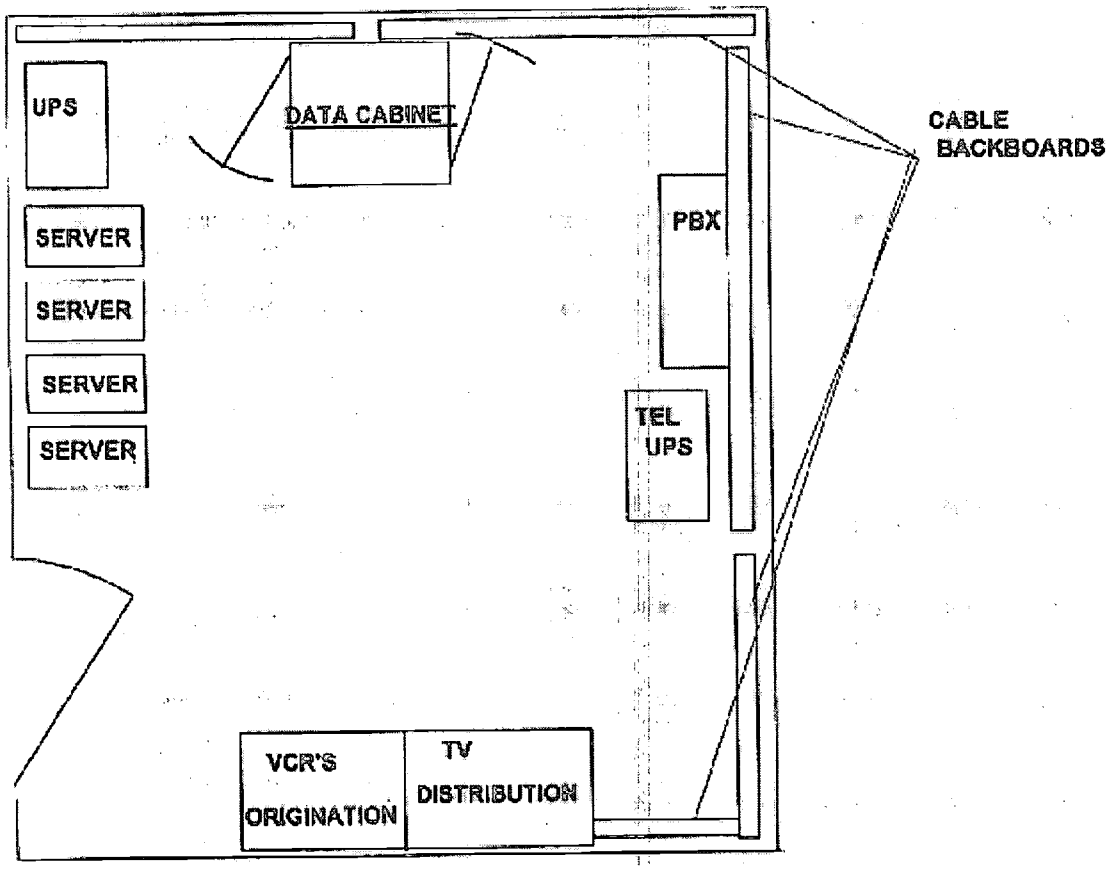
Various configurations can be employed depending on classroom design as long as the capability to interest other parties is available. One option includes one or two very large screen televisions or monitors (47" - 60"), permanently placed in front of the room, that allow students to see and hear the teacher, visuals, and students in other classes. A large monitor in the back allows the teacher to see the students in all receiving and sending locations. A quad - split technique is an effective way to show all remote locations on one screen.

A second option uses three 25" - 26" monitors that are placed in the front of the room. One large monitor (32" - 35") serves as the main monitor for viewing the teacher, visuals or a student while speaking. Three or four small monitors (12" - 13") placed in front of the room and facing the teacher allow the teacher to easily view students in other classrooms as well as the view of his/her classroom that students at remote sites are observing.

Refer to the following pages for specific layouts, diagrams and systems:

Figure 1

CER GENERAL LAYOUT

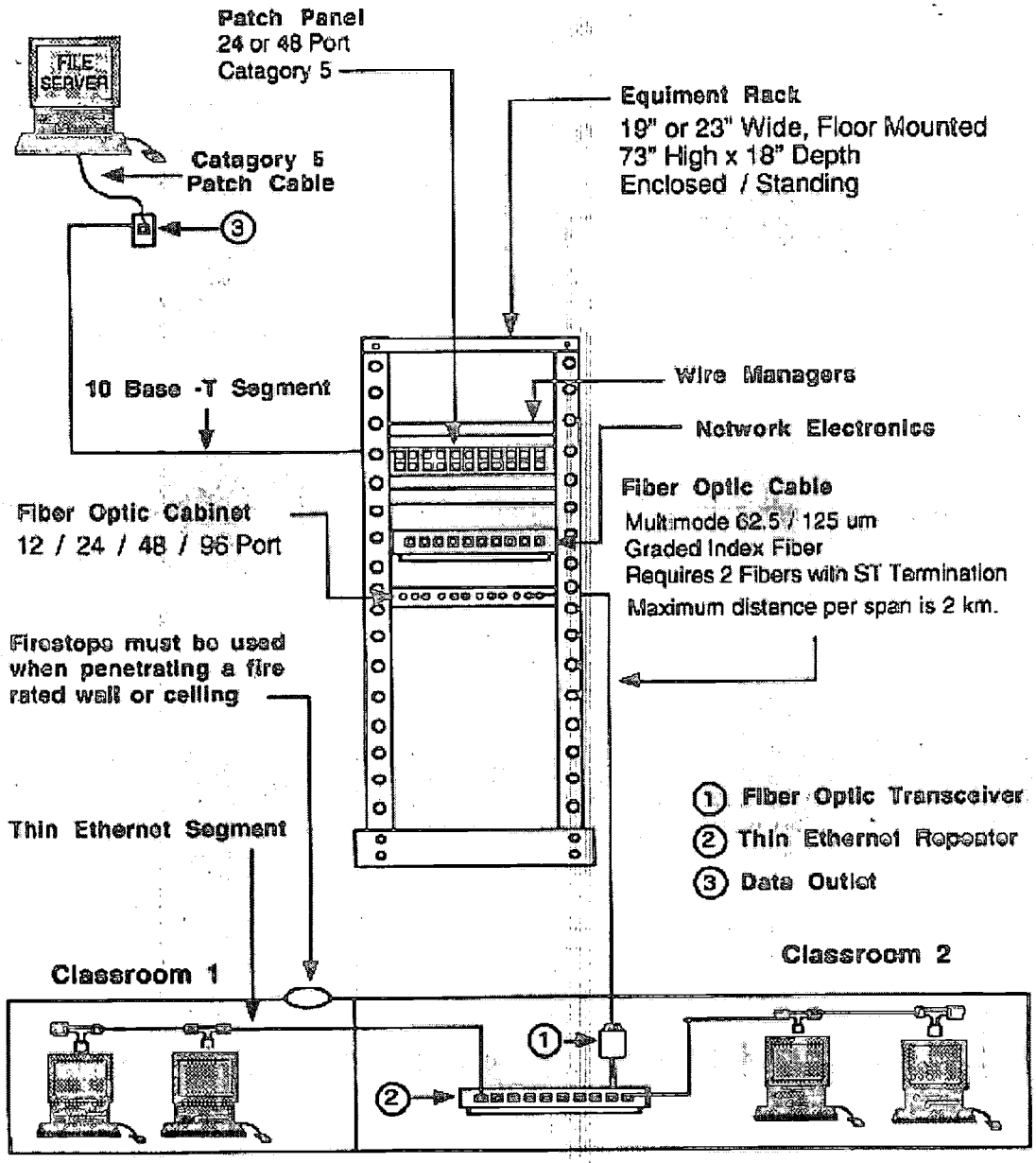


INTERTECH ASSOCIATES,INC.
COMMUNICATIONS & ELECTRONICS CONSULTING ENGINEERS

E-2

Figure 2

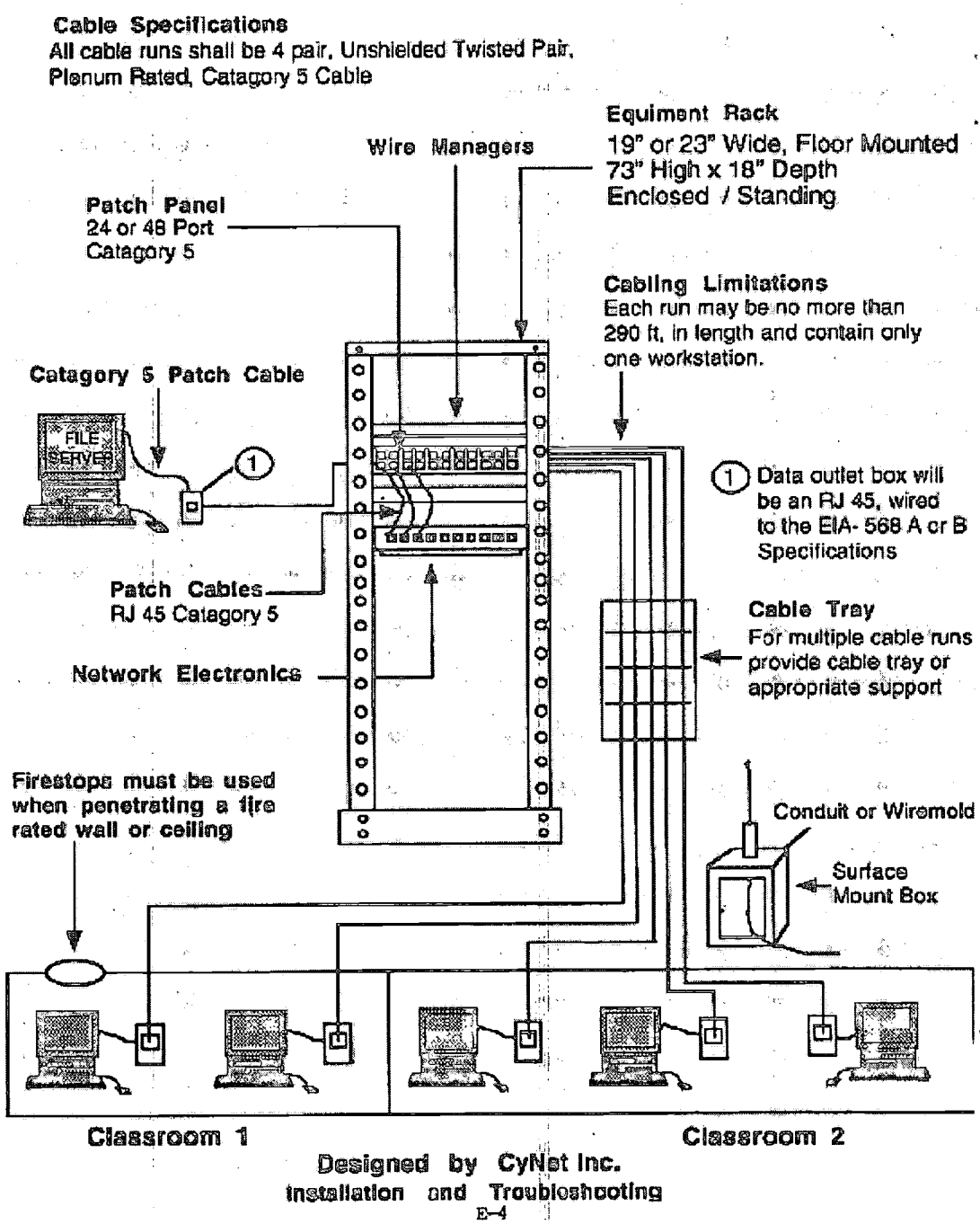
Fiber Optic Point to Point Installation Diagram



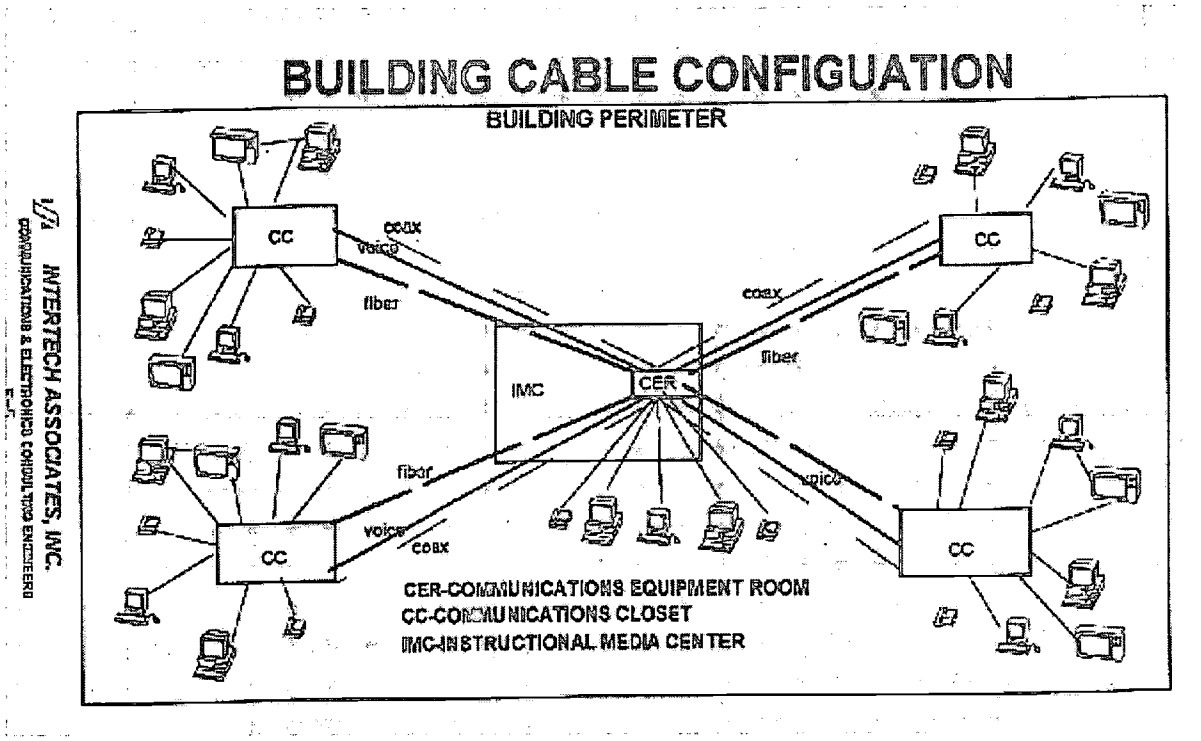
Designed by CyNet Inc.
Installation and Troubleshooting
E-3

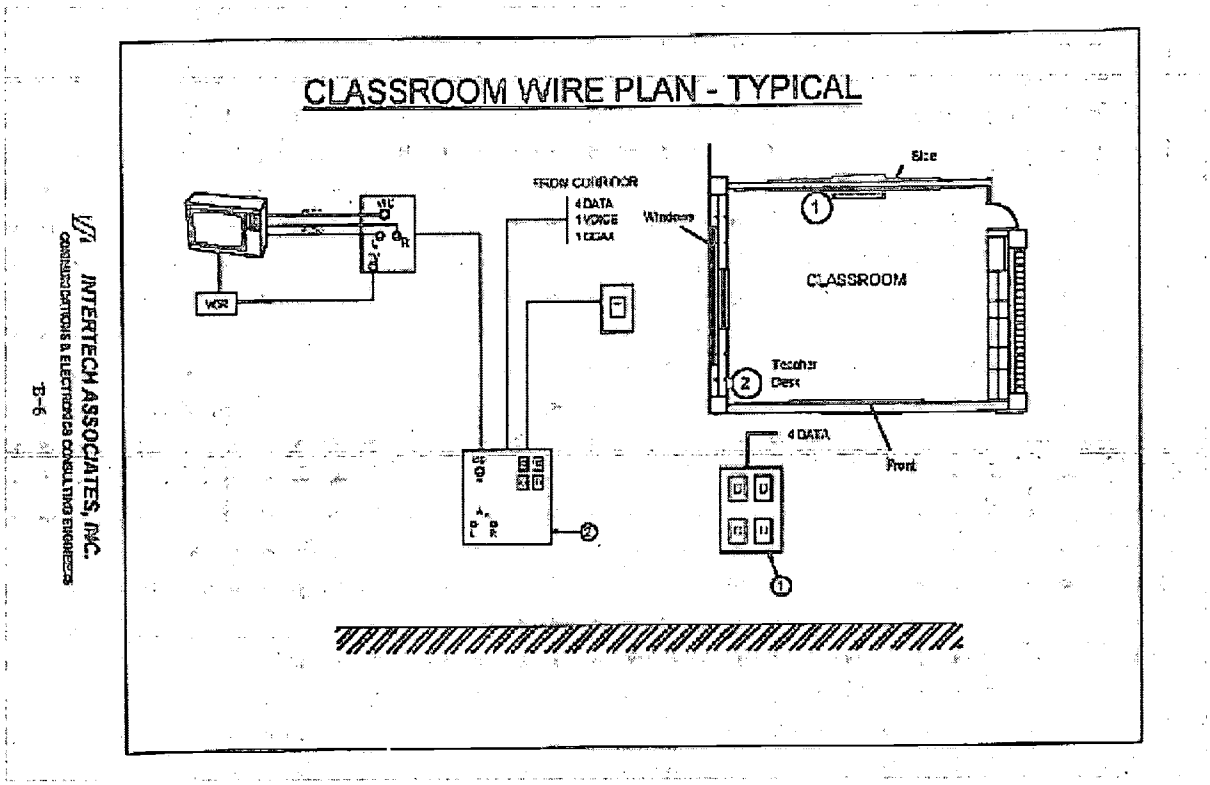
Figure 3

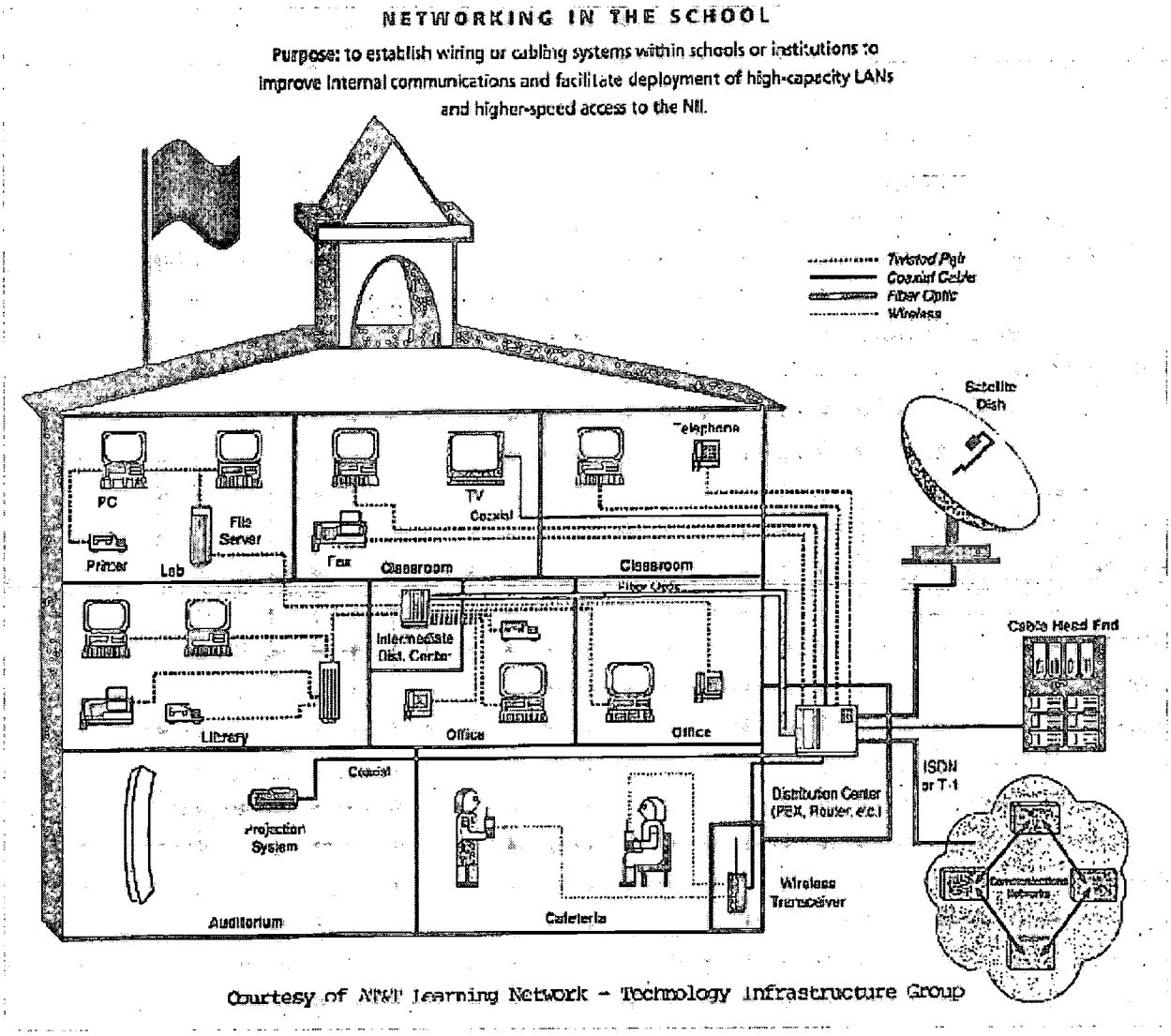
10 Base - T Installation Diagram Using Catagory 5 Cable

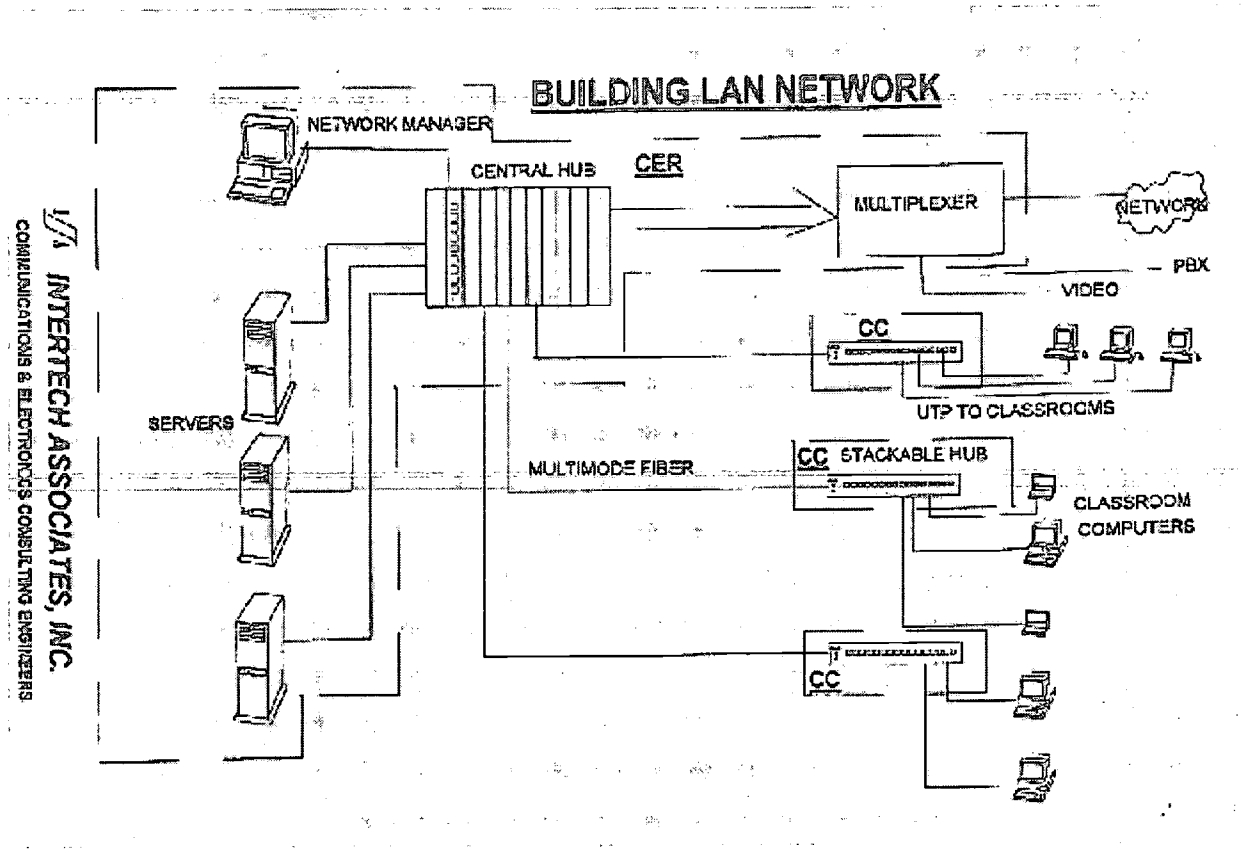


Designed by CyNet Inc.
Installation and Troubleshooting
E-4


BUILDING CABLE CONFIGUATION
BUILDING PERIMETER
CC
coax
voice
fiber
IMC
CER
CER-COMMUNICATIONS EQUIPMENT ROOM
CC-COMMUNICATIONS CLOSET
IMC-INSTRUCTIONAL MEDIA CENTER
INTERTECH ASSOCIATES, INC.


CLASSROOM WIRE PLAN - TYPICAL
FROM CORRIDOR
4 DATA
1 VOICE
Window
CLASSROOM
Teacher
Desk
Front
4 DATA
WAP
INTERTECH ASSOCIATES, INC.
CONSTRUCTION & ELECTRONICS CONSULTING ENGINEERS
B-6




BUILDING LAN NETWORK
NETWORK MANAGER
CENTRAL HUB
CER
MULTIPLEXER
NETWORK
PBX
VIDEO
CC
UTP TO CLASSROOMS
SERVERS
MULTIMODE FIBER
CC STACKABLE HUB
CLASSROOM COMPUTERS
CC
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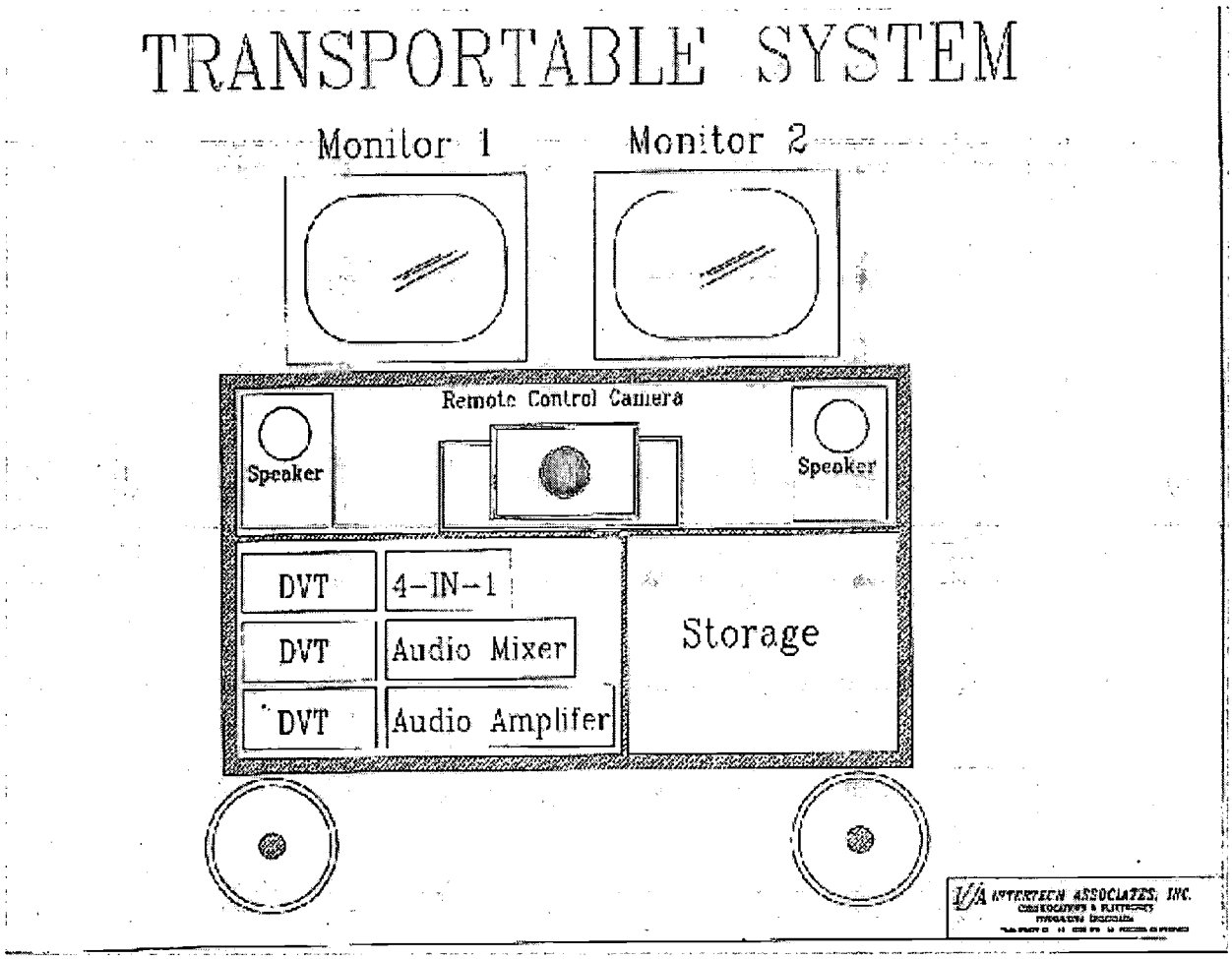
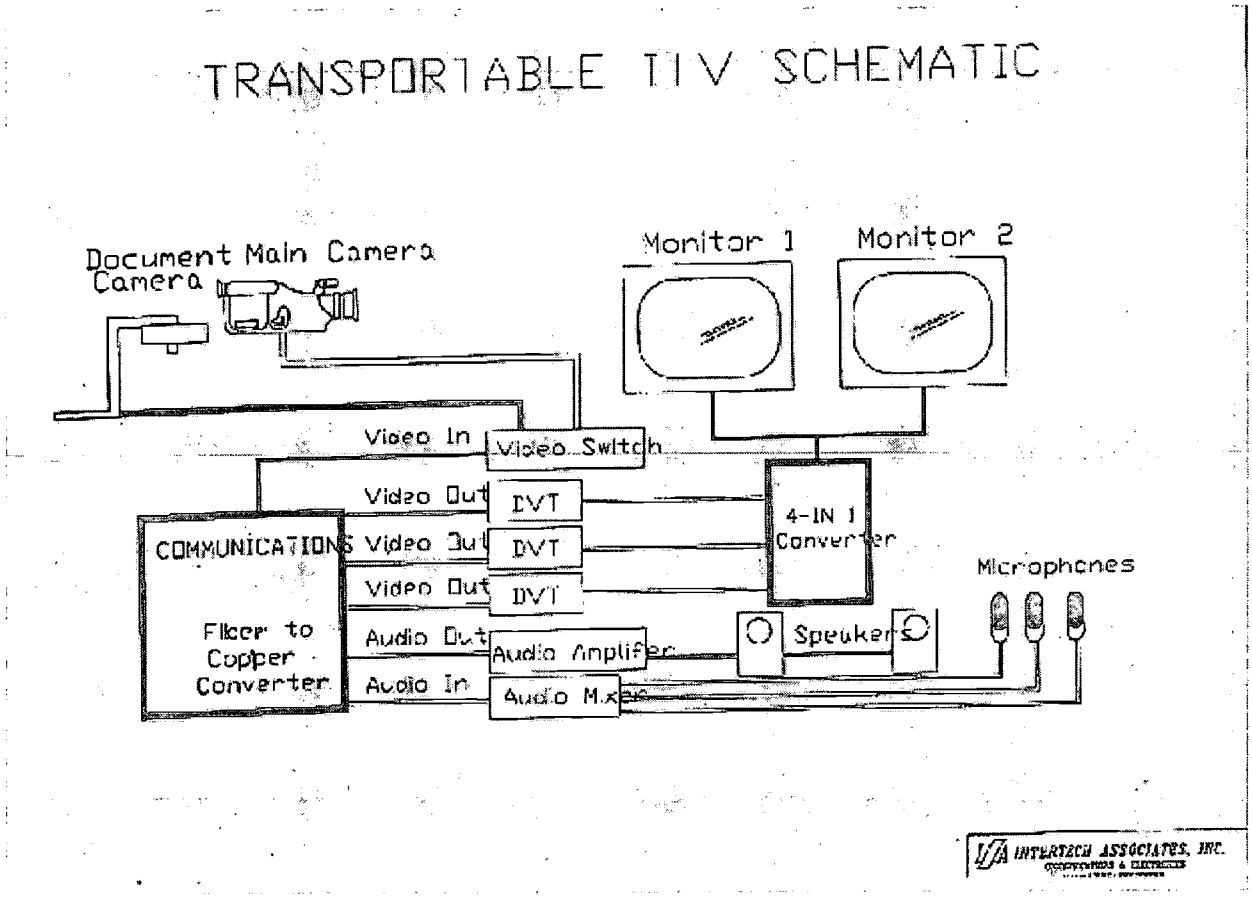
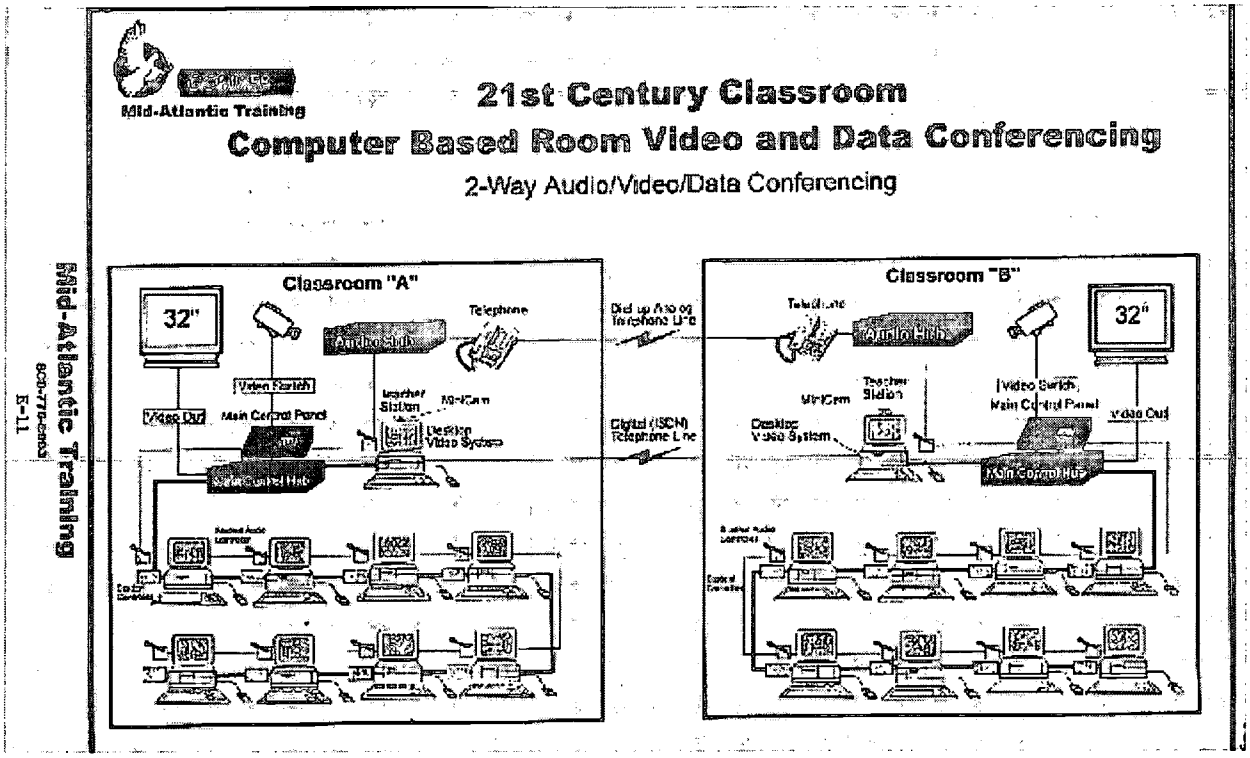
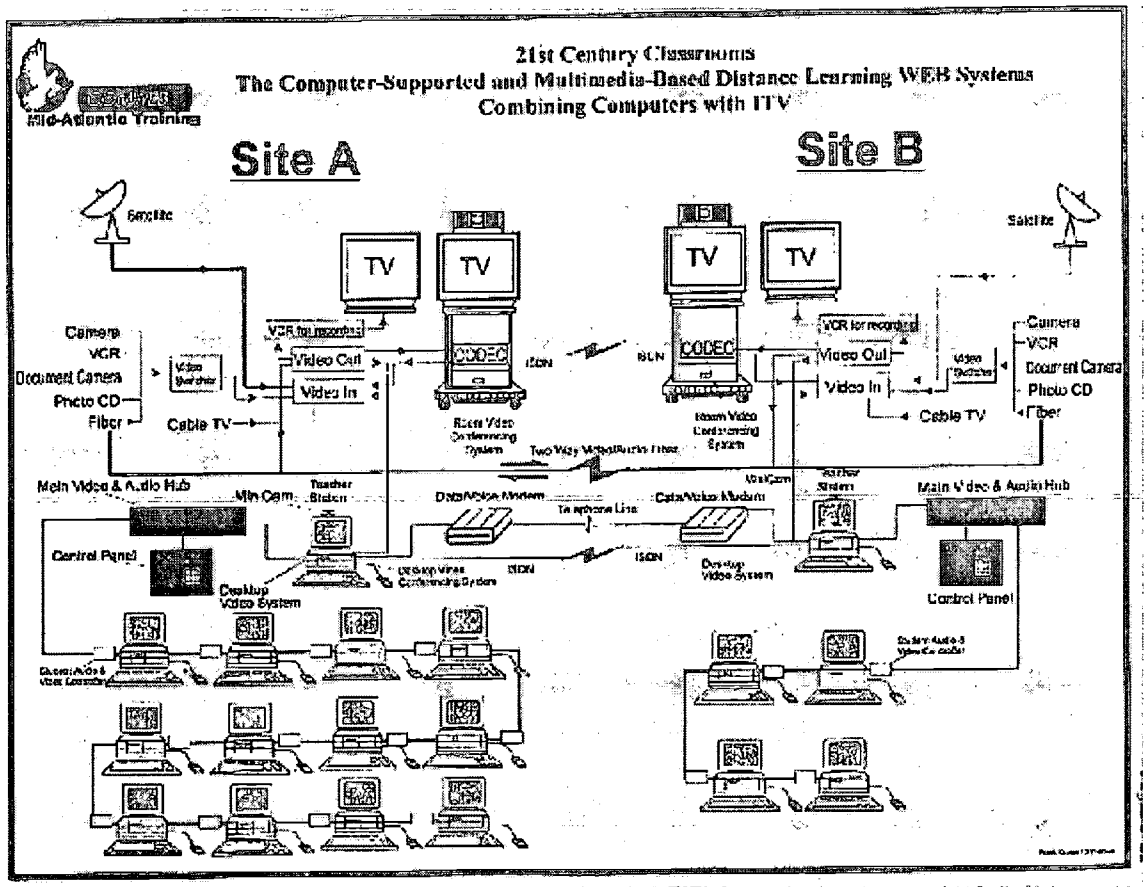
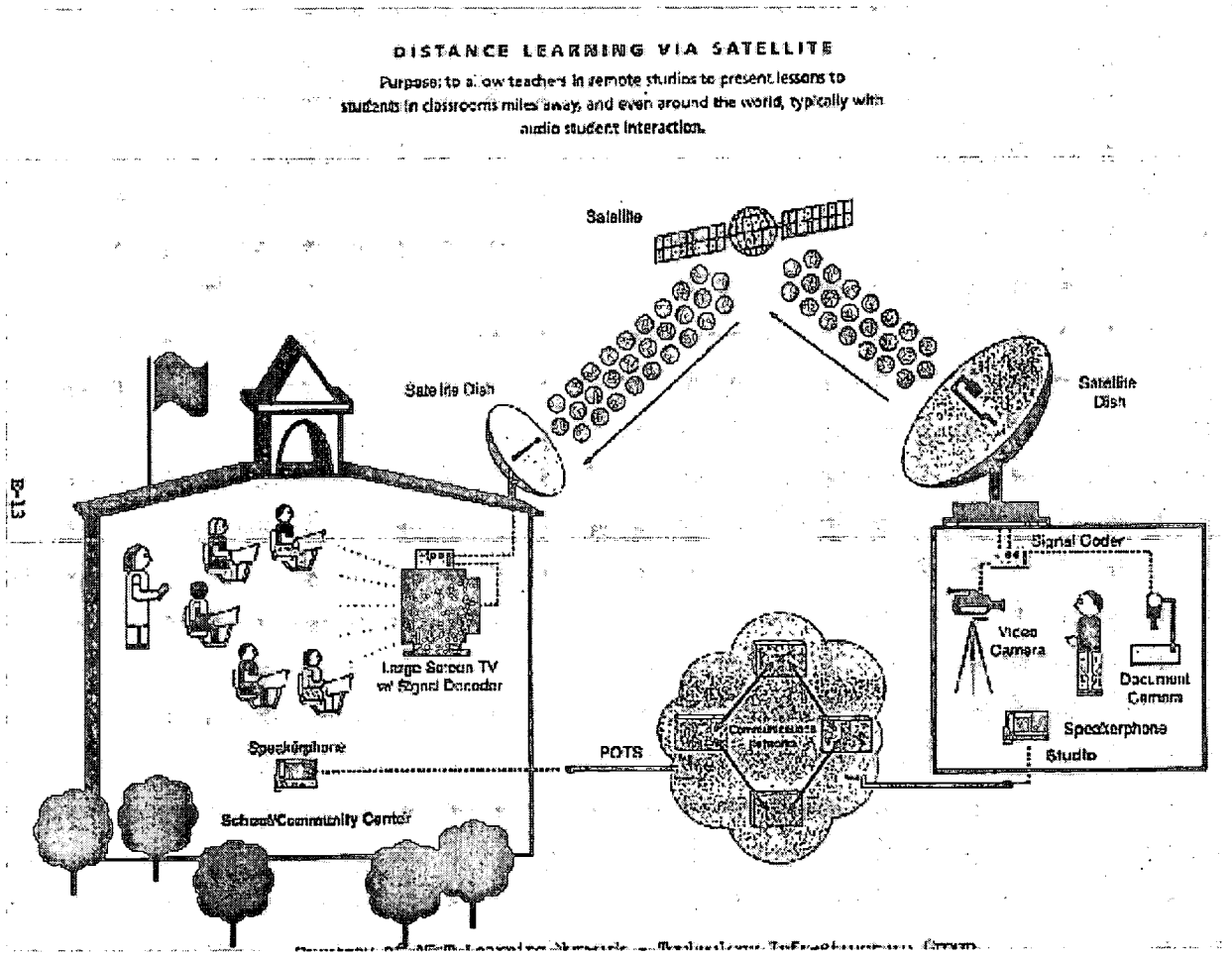
COMMUNICATIONS & ELECTRONICS CONSULTING ENGINEERS




TRANSPORTABLE ITV SCHEMATIC
Document Main Camera
Camera
Monitor 1
Monitor 2
Video In
Video Switch
Video Out
DVT
COMMUNICATIONS
Video Out
DVT
Video Out
DVT
4-IN 1
Converter
Microphones
Fiber to
Copper
Converter
Audio Out
Audio Amplifier
Speakers
Audio In
Audio Mixer
INTERTECH ASSOCIATES, INC.







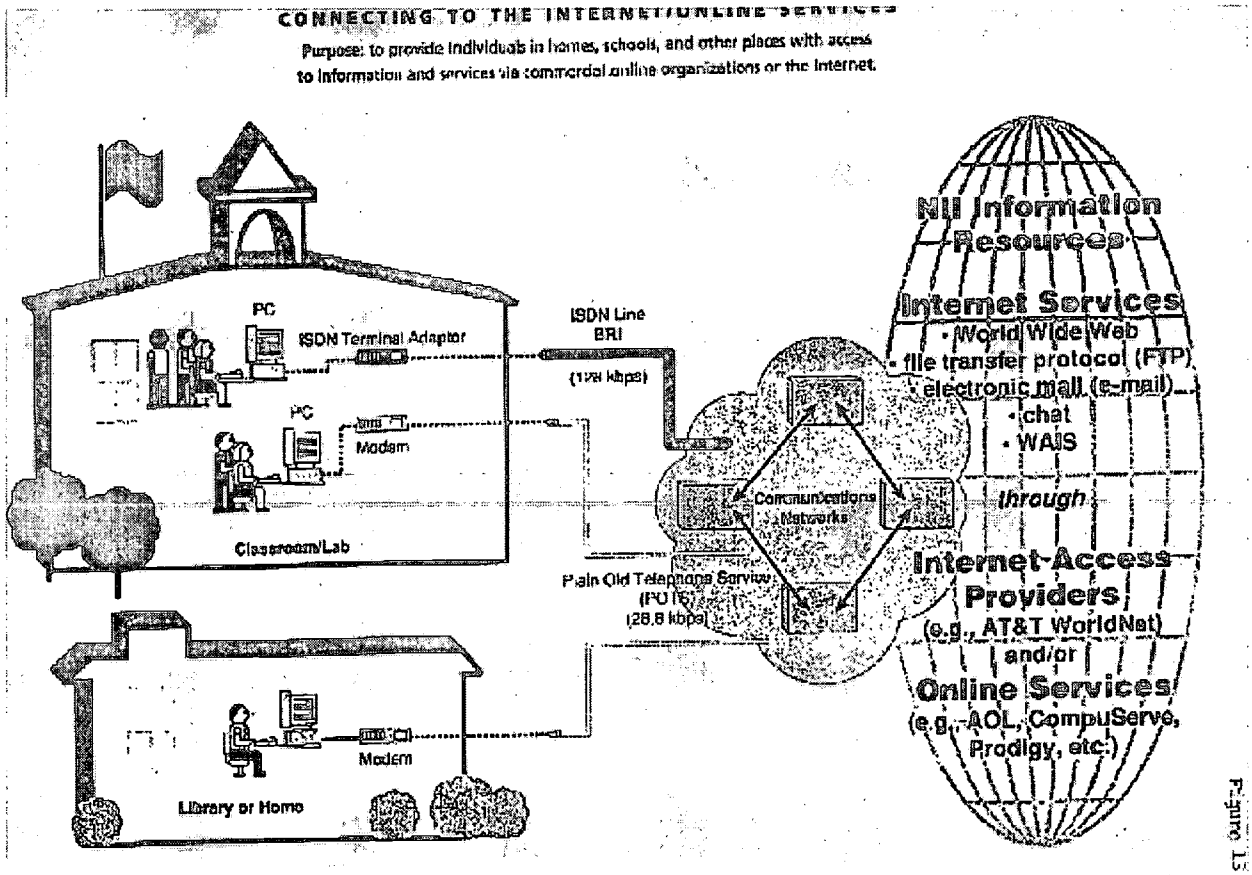
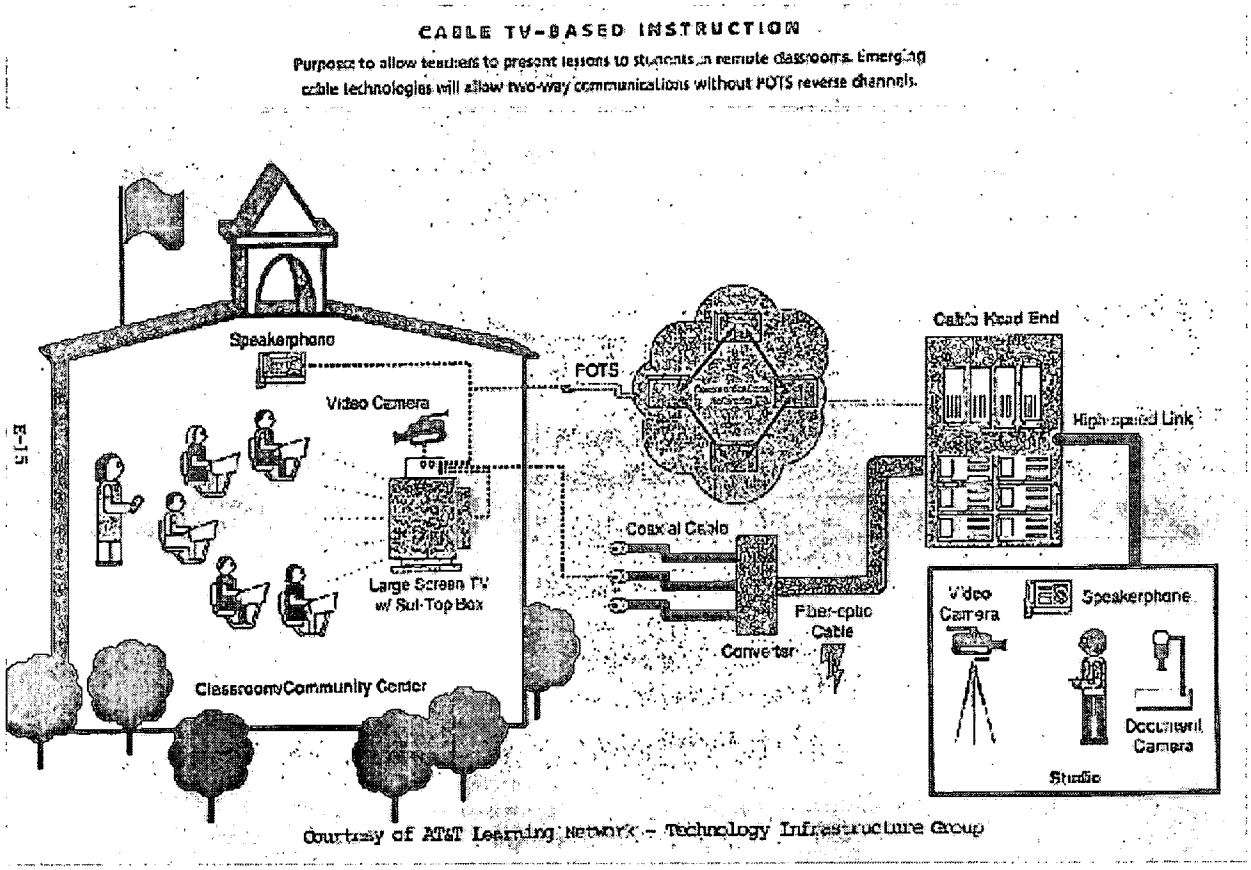
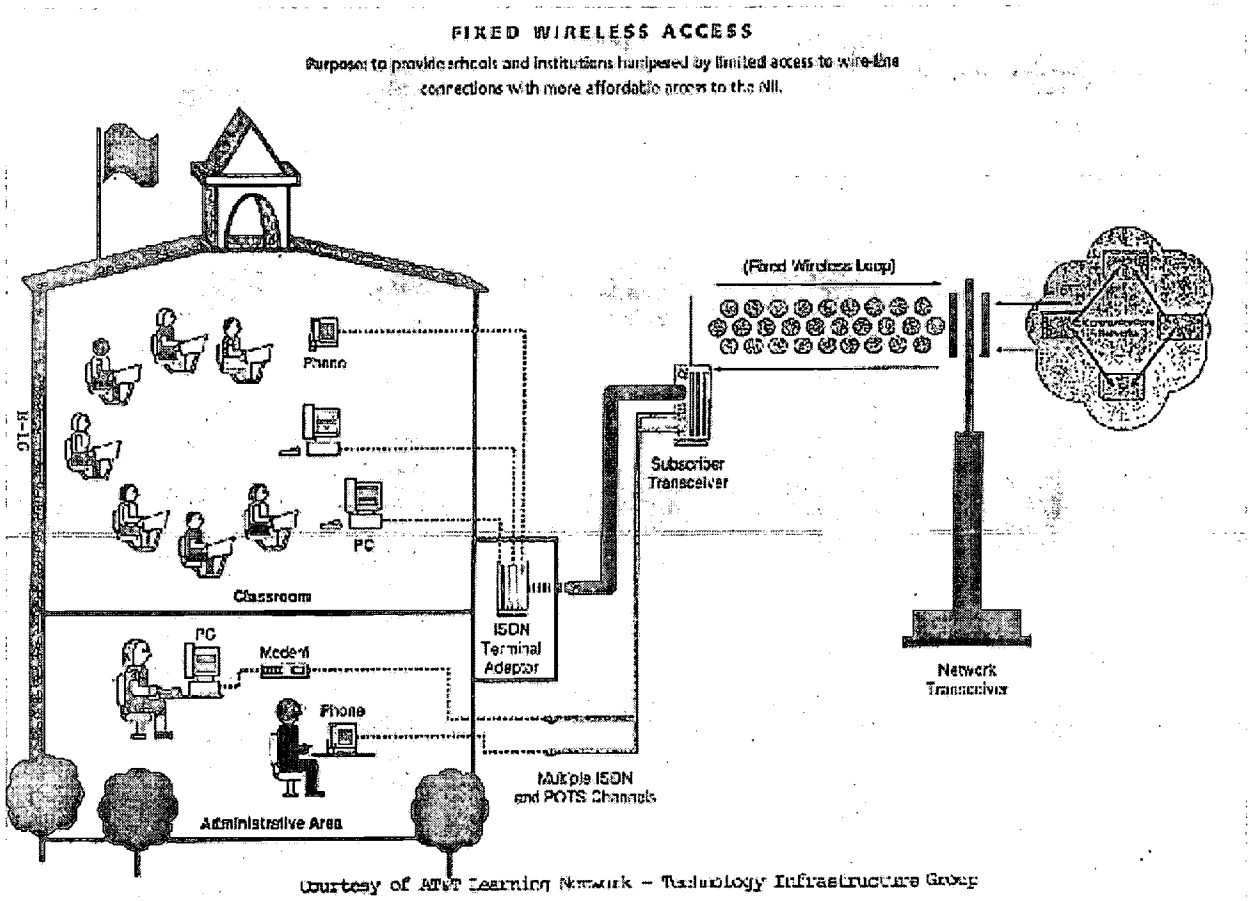


Figure 13

Courtesy of AT&T Learning Network - Technology Infrastructure



E-15



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